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Field Joint Environmental Protection System Vibration/ Pressurization Qualification Final Test Report

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Marshall Space Flight Center, Alabama 35812

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MORTON THIOKOL, INC.

Aerospace Group

Space Operations

P.O. Box 707, Brigham City, Utah 84302-0707 (801) 863-3511

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MORTON THIOKOL, INC.
Space Operations

Field Joint Environmental Protection System
Vibration/Pressurization Qualification
Final Test Report

Prepared by:

Matt Cook
Test Planning and Reporting

Approved by:

Neal Black
Test Planning and Reporting Supervisor

Michael Williams
Systems Test and Support Manager

Roy J. Hyer 3/13/89
Project Engineer

Design Engineer

Certification Planning

Stephen M. Wentz
Reliability

Space Systems Engineering Manager

D M Ketner for
Space Engineering Design Manager

Program Manager

Bruce B. Jeppsen for
Design Supervisor

S. Jansen 3-10-89
System Safety

P C Sydeck 3-15-89
Data Management
ECS# 600

ABSTRACT

The field joint environmental protection system (herein referred to as the joint protection system (JPS)) vibration/pressurization qualification test consisted of flight-simulating environmental conditioning and dynamic environment testing of a JPS test article. The major purposes of the test were to certify that the flight-designed JPS will withstand the dynamic environmental conditions of flight, and to certify that the cartridge check valve (vent valve) will relieve pressure build-up under the JPS during the initial 120 sec (minimum) of flight.

The vibration test article performed satisfactorily and fulfilled all objectives listed in the test plan. The JPS remained intact, no visual anomalies were evident, and the bondlines showed no evidence of separation or degradation throughout the testing. All requirements for venting and pressure release were met. Also, button pull tests of the extruded cork insulation bondlines yielded acceptable results.

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ACRONYMS

CEI	contract end item
FJEPS	field joint environmental protection system
grms	gravity root mean square
JPS	joint protection system
LSC	linear-shaped charge
PSD	power spectral density
RSRM	redesigned solid rocket motor

1

INTRODUCTION

This report documents the procedures used and results obtained from vibration testing the redesigned solid rocket motor (RSRM) field joint environmental protection system (FJEPS), hereafter referred to as the joint protection system (JPS), per CTP-0054, "Qualification Test Plan for the Field Joint Environmental Protection System Vibration/Pressurization Test." The JPS is installed to protect the RSRM field joints from the exterior environment. The test consisted of flight-simulating environmental conditioning and dynamic environment testing of a JPS test article. The major purposes of the test were to certify that the flight-designed JPS will withstand the dynamic environmental conditions of the redesigned solid rocket booster, and to certify that the cartridge check valve (vent valve) will relieve pressure build-up under the JPS during the initial 120 sec (minimum) of flight. Also, an evaluation of the extruded cork insulation bonding was performed after the vibration testing.

The test article was assembled and instrumented according to Morton Thiokol drawings 7U76358 (test art le assembly) and 2U132025 (vibration fixture). The test article was built using sections of current JPS production components, except that the field joint used was a fixture designed to simulate the external contour of the RSRM field joint. Accelerometer and pressure data were acquired to verify the input and response vibration spectrums and the pressure buildup under the JPS during testing.

Testing was conducted at the Morton Thiokol Utah-based test facilities T-3, T-51, T-53, M-15, and M-53 and was completed on 8 Feb 1989.

1.1 BRIEF TEST ARTICLE DESCRIPTION

The test article configuration represented flight hardware, except for the joint simulator fixture (Figures 1 through 4). The test article assembly

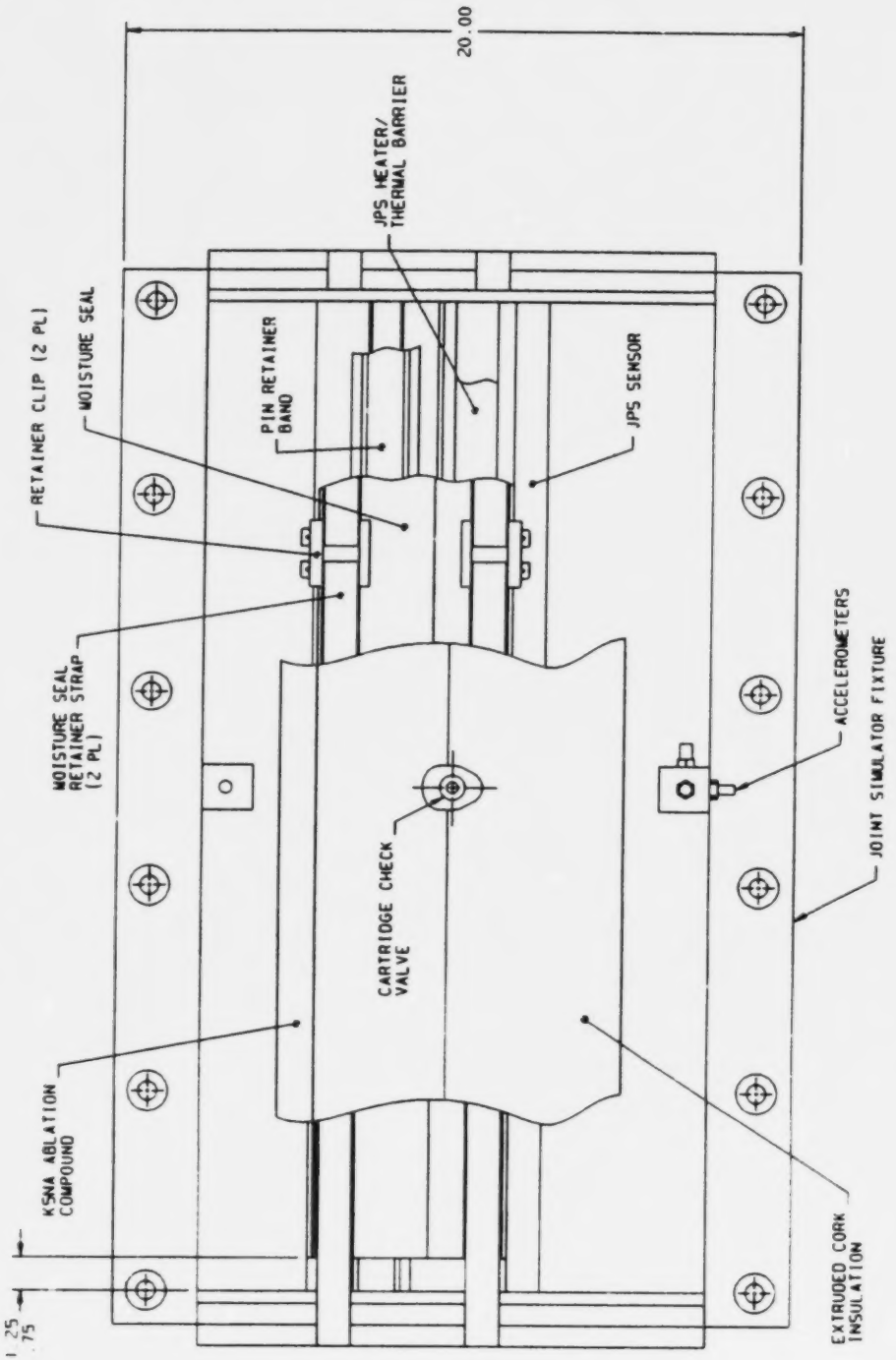

Figure 1. Top View, Field Joint Environmental JPS Vibration/Pressurization Test Article

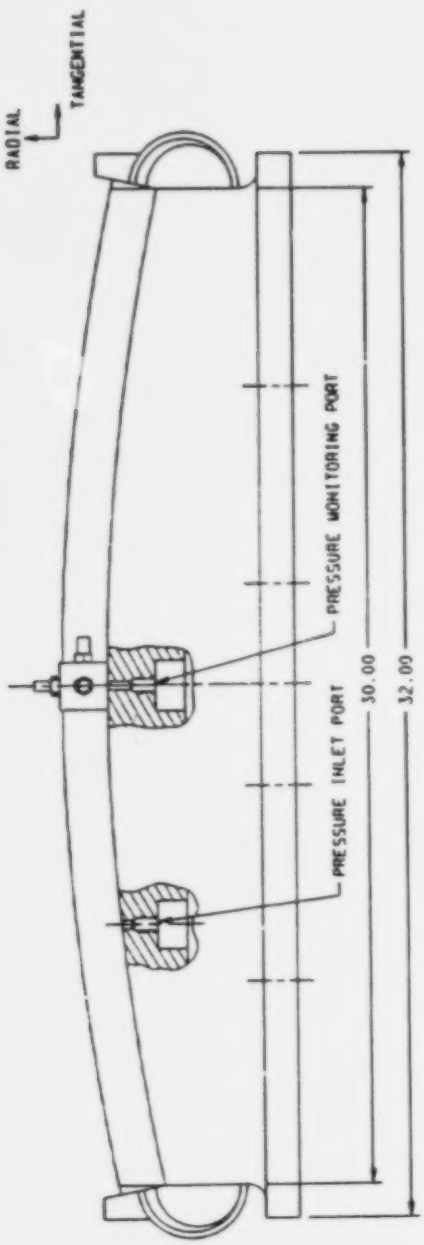

Figure 2. Front View, Field Joint Environmental JPS Vibration/Pressurization Test Article

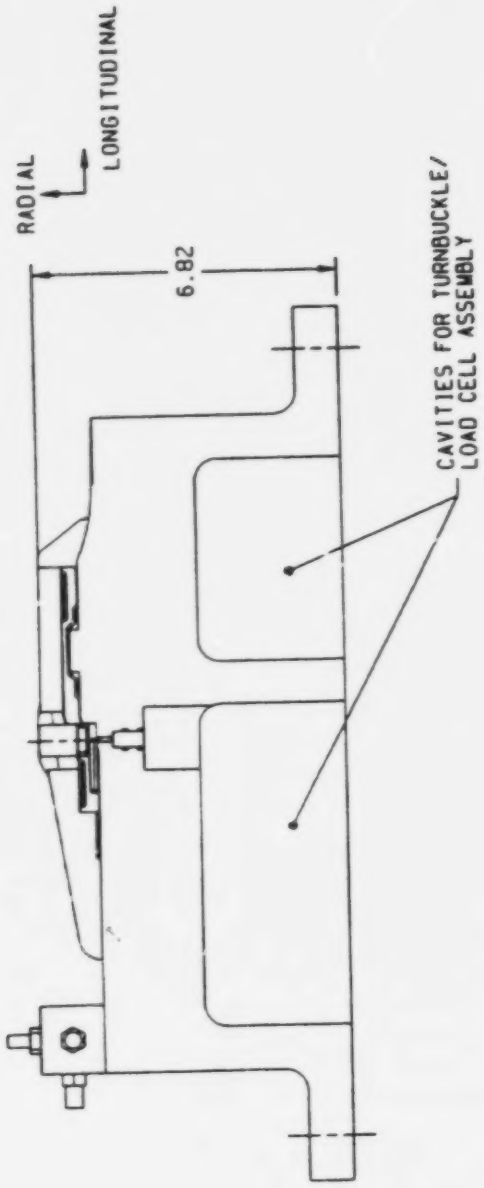

Figure 3. Side View, Field Joint Environmental JPS Vibration/Pressurization Test Article

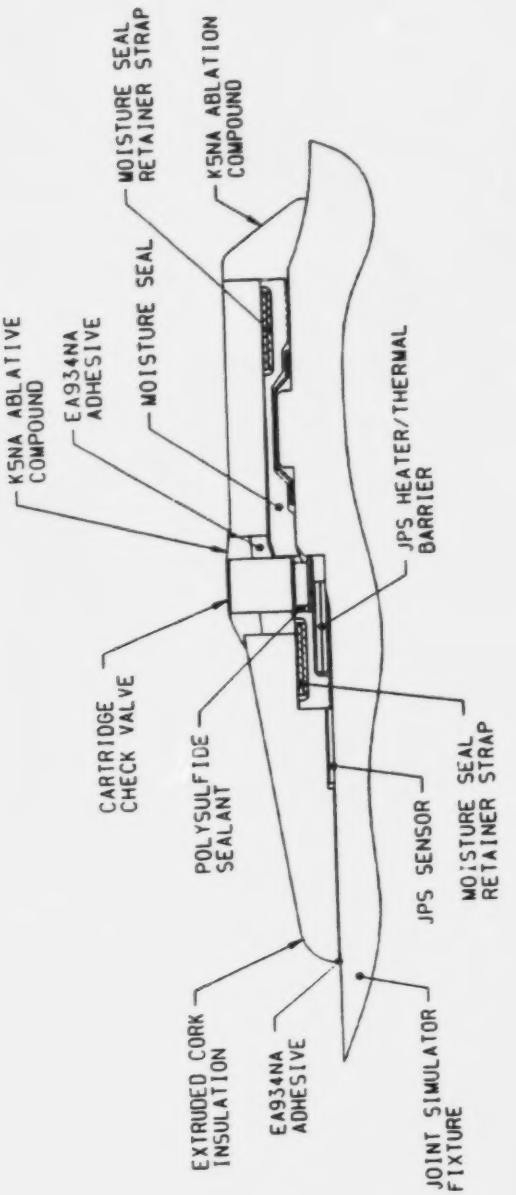

Figure 4. Side View, Closeup, Field Joint Environmental JPS Vibration/Pressurization Test Article

consisted of an aluminum joint simulator fixture and sections of pin retainer band, JPS heater, heater thermal barrier, moisture seal, moisture seal retainer straps, instrumented moisture seal retainer strap clips and links, JPS sensor, extruded cork insulation, and K5NA ablation compound. In addition, a cartridge check valve was installed into the center of the assembly.

2

OBJECTIVES

The JPS vibration/pressurization test objectives were derived from the objectives in TWR-15723, Rev. C, "Redesign D&V Plan," to satisfy the requirements of contract end item (CEI) specification CPW1-3609. The objectives are listed with the CEI paragraph numbers as follows:

a. Certify that the JPS shall remain intact through simulated flight, post-separation, water impact and, as a goal, through recovery vibration and shock criteria. (3.2.1.11.d, 3.2.7.2.2.b)

b. Certify that the JPS structures and components are designed to demonstrate the life factor requirements. (3.3.6.5)

c. Certify that the JPS is designed to preclude the shedding of debris (Debris Prevention) from the elements during prelaunch and flight operations that would jeopardize the flightcrew and/or mission success. (3.2.6.5)

d. Certify that the vent valve will relieve the pressure buildup under the JPS during the initial 120 sec minimum of both flight random and vehicle dynamics vibration criteria in each axis. (3.2.1.11.d, 3.2.7.2.2.b)

e. Evaluate the JPS bondline performance when subjected to the prelaunch natural environments as listed:

    --Air temperature
    --Humidity
    --Rain
    --Salt air

f. Evaluate the JPS post-test structural integrity (adhesive bondlines) through button pull tests.

3

APPLICABLE DOCUMENTS

Morton Thiokol Documents	Title
CPW1-3600	Prime Equipment Contract End Item (CEI) Detail Specifications
CTP-0054	Qualification Test Plan for the Field Joint Environmental Protection System Vibration/Pressurization Test
DPD 400	Data Procurement Document No. 400
SE-019-049-2H	Solid Rocket Booster Vibration, Acoustic and Shock Design and Test Criteria
STW5-2994	Paint, Polyethylene, Chlorosulfonated
STW5-3183	Ablation Compound, Cork Filled (K5NA)
STW4-3218	Epoxy Resin Adhesive, Nonasbestos, Structural Bonding (EA 934NA)
STW5-3225	Coatings, Epoxy-Polyamide
STW5-3226	Primer, Zinc-Rich, Epoxy-Polyamide
TWR-10163 (CD)	Safety Plan for Space Shuttle Solid Rocket Motor Project
TWR-15671	Quality Plan for the SRM Redesign Program
TWR-15723	Redesign D&V Plan
TWR-17230	Cork Extrusion Mechanical Characterization Final Test Report
TWR-19138	FJEPS Vibration/Pressurization Test Flash Report
GS&HM	Morton Thiokol/Wasatch Operations General Safety and Health Manual

Military Documents	Title
MIL-STD-810C	Environmental Test Methods
MIL-STD-810D	Environmental Test Methods and Engineering Guidelines
MIL-S-8802	Type I Cl B-2 Sealant (PR1422 Polysulfide)
MIL-STD-45662	Calibration System Requirements

Drawing No.	
2U132025	Vibration Fixture RSRM Field Joint
7U76358	Test Assembly, Vibration/Pressure

4

RESULTS SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

4.1 RESULTS SUMMARY

This section contains an executive summary of the key results from the test data evaluation and post-test inspection. Additional information and details can be found in Section 7 of this report.

The vibration test article performed satisfactorily and fulfilled all of the objectives listed in CTP-0054. The JPS remained intact, no visual anomalies were evident, and the EA 934NA adhesive and K5NA ablation compound bondlines showed no evidence of separation or degradation throughout the testing. The cartridge check valve performed as expected. All requirements for venting and pressure release were met and the cartridge check valve remained securely bonded in place. Button pull tests of the bonds between the extruded cork insulation and the aluminum joint simulator fixture, moisture seal, and moisture seal retainer straps yielded satisfactory results.

Throughout the vibration environment tests there was no drop or change in the moisture seal retainer strap tension. During all of the flight random and vehicle dynamics pressurization tests there was no internal pressure drop.

For the water impact shock test, the impact-simulating pulse duration criterion was changed from 0.050 to 0.010 sec to accommodate the capabilities of the test equipment. Longitudinal axis shock No. 1 was run with a loose lead on the control accelerometer, and thus the article was over-tested to 70.23 g (test criteria peak level was 20 g). Tangential axis shock No. 1 was run to 19.77 g (test criteria peak level was 8 g). The cause of the tangential over-test is unknown. Since no visual damage was done to the test article in each over-test, both test runs were acceptable.

Based on the results of these tests, it can be concluded that the test was successful.

4.2 CONCLUSIONS

Overall, the results of this test were satisfactory. Test results indicate that when proper installation procedures are followed the JPS will remain intact throughout the flight environment. The JPS tested remained intact and did not come free from the joint simulator fixture. No evidence of debris was present and the cartridge check valve relieved the pressure built up under the JPS as needed. All of the bondlines were in excellent condition and post-test pull tests showed greater-than-anticipated bondline strengths.

4.2.1 Requirement Traceability

Listed following are the conclusions as they correspond to the objectives and CEI paragraphs. Additional information to support these conclusions can be found in Sections 7.2 and 7.3 of this report.

Objective	CEI Paragraph	Conclusions
Certify that the JPS shall remain intact through simulated flight, post-separation, water impact and, as a goal, through recovery vibration and shock criteria.	3.3.1.11d. The field joint protection system shall remain intact through flight and, as a goal, through recovery. 3.2.7.2.2b: Induced Environment Loads. The RSRM shall be designed to withstand postseparation-through-recovery loads as specified...	Certified. Throughout testing, all of the bondlines and components of the test article remained intact and did not degrade in any way.
Certify that the JPS structures and components are designed to demonstrate the life factor requirements.	3.3.6.5: Life Factors. The RSRM shall be designed to withstand fatigue and fracture mechanics requirements as specified...	Certified. The test article was subjected to accelerated environmental conditioning prior to successful completion of vibration and pressurization testing.

Objective	CEI Paragraph	Conclusions
Certify that the JPS is designed to preclude the shedding of debris (Debris Prevention) from the elements during prelaunch and flight operations that would jeopardize the flight crew and/or mission success.	3.2.6.5: Debris Prevention. The SRM shall be designed to preclude the shedding of debris from the elements during prelaunch and flight operations...	Certified. Throughout testing, all components of the test article remained intact and did not degrade in any way.
Certify that the vent valve will relieve the pressure buildup under the JPS during the initial 120 sec minimum of both flight random and vehicle dynamics vibration criteria in each axis.	3.3.1.11d. The field joint protection system shall remain intact through flight and, as a goal, through recovery. 3.2.7.2.2b: Induced Environment Loads. The RSRM shall be designed to withstand postseparation-through- recovery loads as specified...	Certified. The vent valve performed as designed and relieved the JPS internal pressure during the initial 120 sec minimum of each flight random and vehicle dynamics vibration test. Salt deposits were present on the vent valve from the environmental conditioning, but the deposits did not impact valve performance.
Evaluate the JPS bondline performance when subjected to the prelaunch natural environments as listed: --Air temperature --Humidity --Rain --Salt air	None	The test article was subjected to the specified simulated prelaunch environments and all bondlines remained intact and did not degrade in any way.
Evaluate the JPS post-test structural integrity (adhesive bondlines) through button pull tests.	None	Cork insulation pull tests yielded results as expected, and all breaking strength values were higher than expected.

4.3 RECOMMENDATIONS

Based on the results of this test, it is recommended that the use of the flight configuration JPS, as documented in this report, should be continued.

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INSTRUMENTATION

Vibration test instrumentation consisted of a triaxial accelerometer (A002-A004) mounted on the joint simulator fixture to measure response frequencies, and a single accelerometer (A001) mounted to the shaker table input plate to control input frequencies (Figure 1). In addition, a mass flowmeter controlled air flowing into the cavity under the JPS, and a pressure gage (P001) monitored the pressure buildup (Figure 2).

6

PHOTOGRAPHY

Pretest and post-test photographs of the test article were taken. Figures 5 through 8 show the test setup and post-test condition of the test article.

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Figure 5. JPS Test Article Subject to Salt Spray Conditioning

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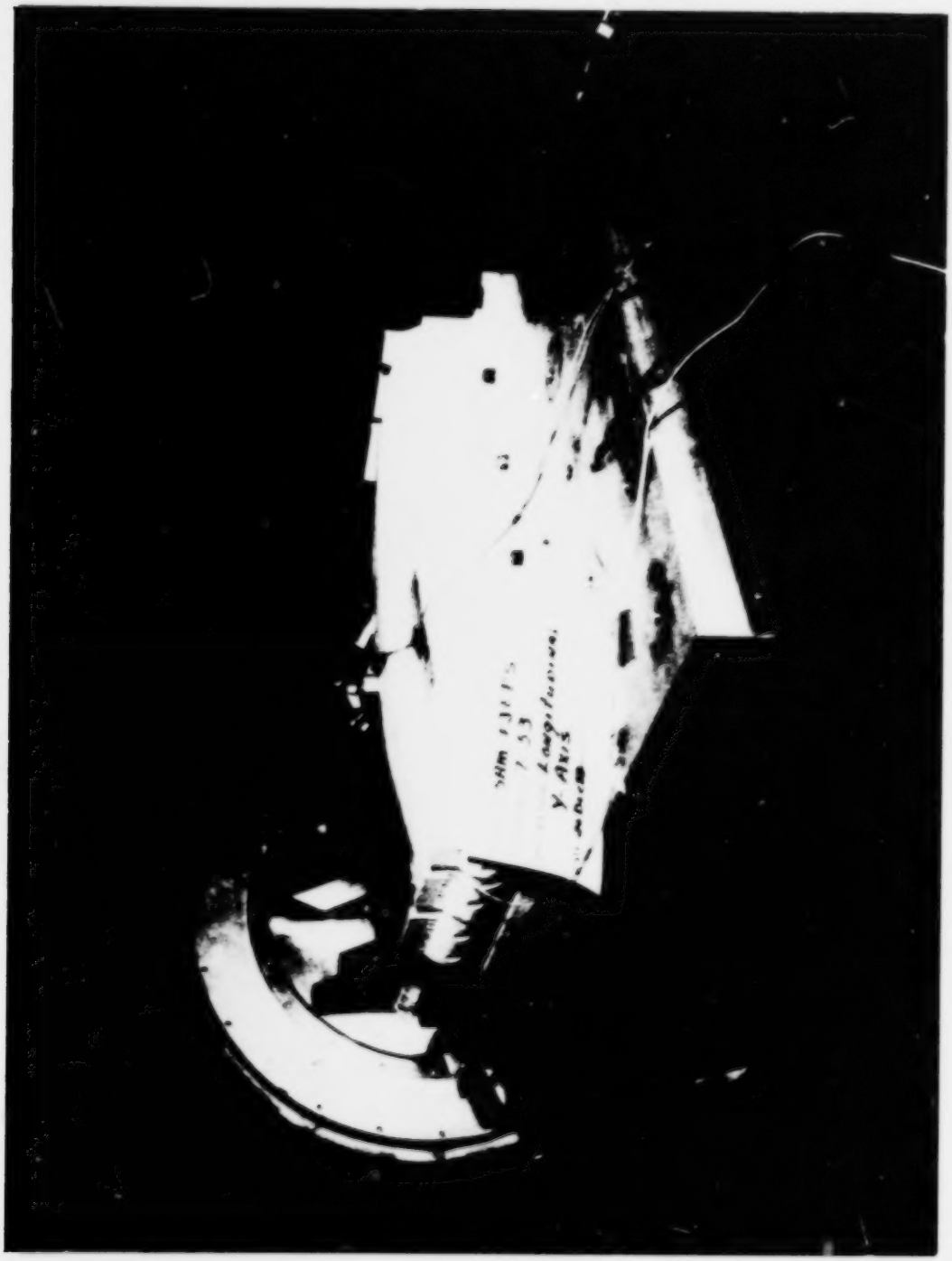

Figure 6. JPS Test Article Positioned for Longitudinal Vibration

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Figure 7. JPS Test Article Positioned for Tangential Vibration

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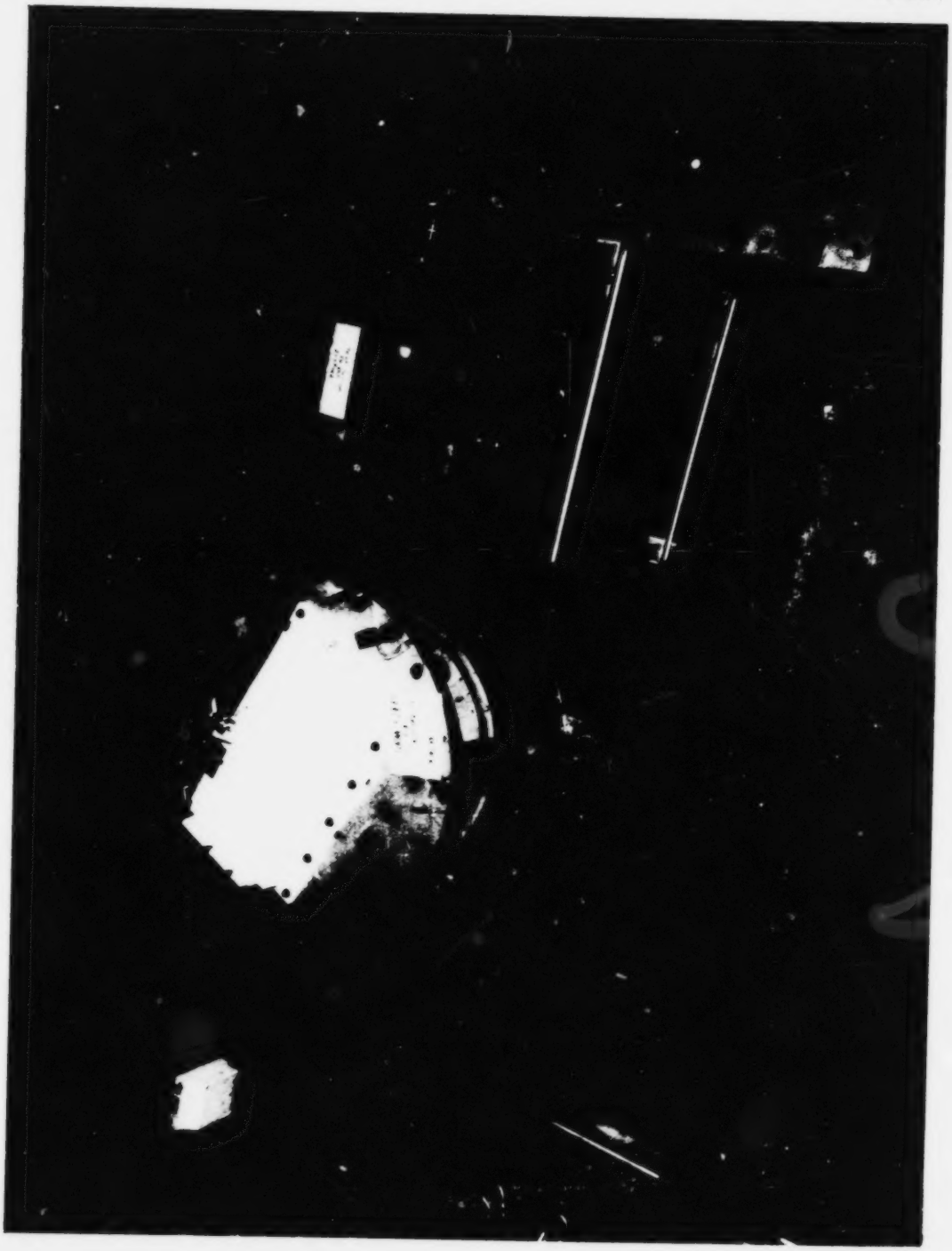

Figure 8. JPS Test Article Positioned for Radial Vibration

7

RESULTS AND DISCUSSION

Prior to the vibration/pressurization testing, the test article was assembled and subjected to accelerated environmental conditioning.

7.1 TEST ARTICLE DESCRIPTION

The test article configuration was designed to certify the JPS. Test article configuration represented flight hardware, except for the joint simulator fixture (Figures 1 through 4). The test article assembly consisted of an aluminum joint simulator fixture and sections of pin retainer band, JPS heater, heater thermal barrier, moisture seal, moisture seal retainer straps, instrumented moisture seal retainer strap clips and links, JPS sensor, extruded cork insulation, and K5NA ablation compound. In addition, a cartridge check valve was installed into the center of the assembly.

7.1.1 Joint Simulator Fixture

Drawing 2U132025 defined the joint simulator fixture configuration, which was designed to simulate the external profile of an assembled RSRM field joint and allow for the installation of the JPS. The fixture was machined from aluminum to be 32 in. long by 20 in. wide by 6.2 in. high. The 32-in. test article length was selected using the following criteria:

a. Similarity to the test article length used in the nozzle linear-shaped charge (LSC) and the systems tunnel qualification tests (approximately 30-to-40-in. length).

b. As close to the maximum length possible to achieve the 35.2-grms level required for reentry random vibration.

   (Analysis shows that vibration modes which cause element lifting, separation, debonding, etc., are relatively high in frequency and pure radial, tangential, or longitudinal modes. Although 32 in. is only about 15 percent of the JPS circumference, test article length for the lifting, separation, debonding, etc., modes is not a factor.)

A requirement of the JPS vibration fixture was to simulate and monitor pressure buildup under and venting through the cartridge check valve in the JPS. To accomplish this, two pressure ports were drilled into the joint simulator fixture: one to allow an airflow into the volume under the JPS, and one to monitor the pressure directly under the cartridge check valve in the JPS (Figure 2).

To ensure that tension in the moisture seal retainer straps could be monitored and verified to be within the 1,300-to-3,000-lb range during assembly, two cavities were machined into the joint simulator fixture to accommodate two turnbuckle/load cell assemblies to which the straps were attached and tightened (Figure 3).

Prior to installing the JPS, the fixture was grit blasted, vapor degreased, and spray painted with STW5-3226 zinc-rich primer and STW5-3225 top coat.

7.1.2 Vibration Test Article Assembly

Assembly and instrumentation of the JPS vibration fixture was conducted at the Morton Thiokol M-15 facility and was defined by drawing 7U76358. The assembly consisted of sections of the pin retainer band, JPS heater, heater thermal barrier, moisture seal, moisture seal retainer straps, instrumented moisture seal retainer strap clips and links, JPS sensor, extruded cork insulation, and K5NA ablation compound installed on the joint simulator fixture. In addition, a cartridge check valve was installed into the center of the JPS assembly.

To obtain an assembly which was capable of holding pressure, the moisture seal was trimmed 0.75 to 2.0 in. on either end and sealed in place using polysulfide sealant (MIL-S-8802). The cartridge check valve was then bonded to the moisture seal with polysulfide sealant (MIL-S-8802).

Once the seal was verified, the moisture seal retainer straps were installed and tightened to 2,990 ±10 lb tension. To monitor and record the tension in the straps, the straps were installed using two specially modified retainer strap clip and link assemblies (the modification to the strap clip and link assemblies consisted of instrumenting them to measure load) and two

turnbuckle/load cell assemblies. The straps were allowed a 30-min period of relaxation and then retightened, after which the heater sensor was put in place.

Finally, EA 934NA adhesive was applied to both the joint simulator fixture and the extruded cork insulation. The cork was positioned in place and cured inside a vacuum bag for 8 hr. After cure, the adhesive surrounding the upper 0.25 in. of the cartridge check valve was removed and replaced with K5NA (Figure 4). K5NA was applied at the aft end of the cork, and all the cork and K5NA were painted with white polyethylene paint (STW5-2994). Assembled, the test article weighed 171.4 lb.

7.2 ACCELERATED ENVIRONMENTAL CONDITIONING

Prior to vibration testing, the test article was subjected to temperature, humidity, salt spray, and rain conditioning per CTP-0054 and MIL-STD-810D to simulate the prelaunch natural environment. This conditioning took place from 29 Nov to 12 Dec 1988.

7.2.1 High-Temperature, High-Humidity Conditioning

Initially, the test article was placed in the Morton Thiokol T-51 test facility and subjected to an environment of 120° +10-0°F and 90 +10-0 percent relative humidity for 48 hr minimum (Figure 9). Upon completion of this conditioning, the test article was placed in a 75° ±10°F environment for 24 hr minimum and allowed to return to ambient condition.

7.2.2 Salt Spray Conditioning

Following the high-temperature, high-humidity, and return-to-ambient conditioning cycle, the test article was placed in the Morton Thiokol T-3 test facility and subjected to a 95° ±10°F salt spray conditioning for 48 hr (Table 1 and Figure 5). Upon completion of this conditioning, the test article was placed in a 75° ±10°F environment for 48 hr and allowed to return to ambient conditions. Postconditioning inspection of the test article showed salt deposits accumulated in and around the vent valve.

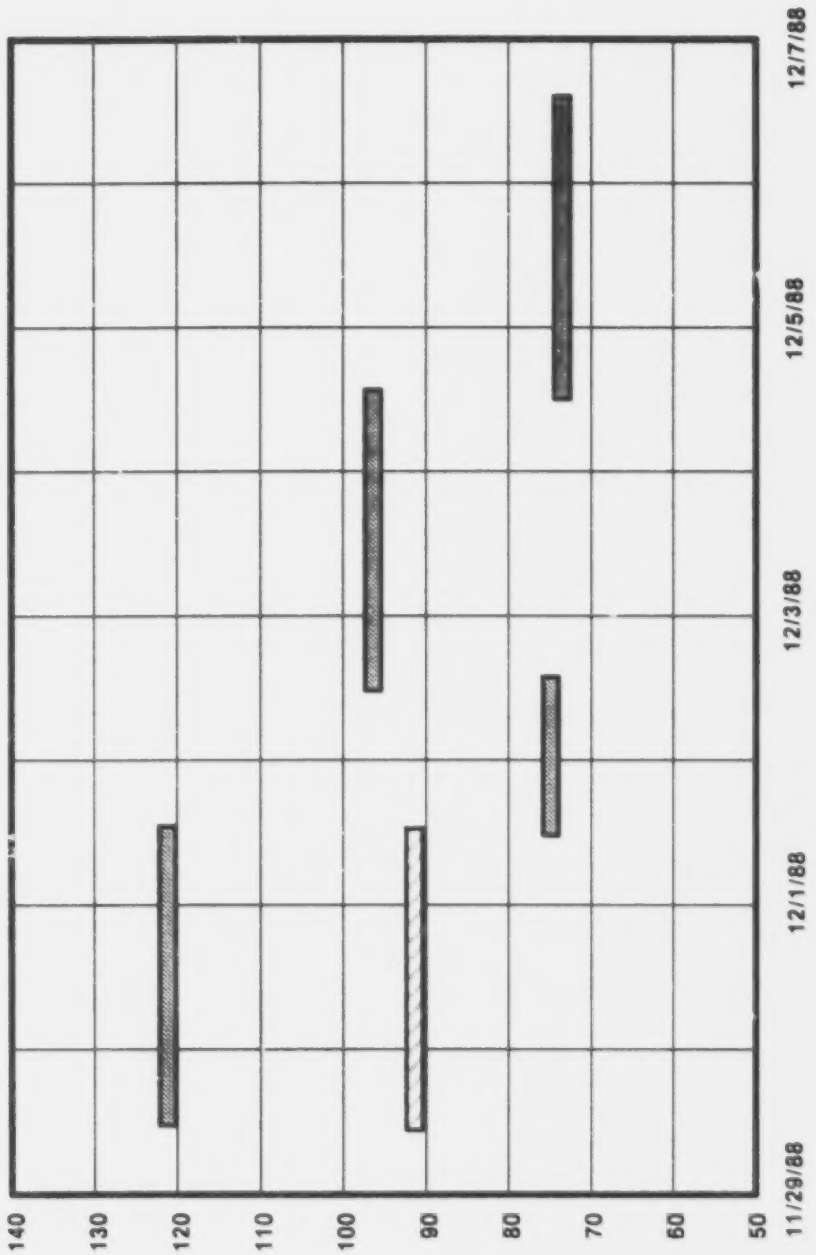

Figure 9. JPS Test Article Salt Spray Conditioning—High Temperature and Humidity

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Table 1. JPS Test Article Salt Fog Conditioning Data

Required			
pH	Specific Gravity	Temperature	Fallout
6.5 to 7.2	1.023 to 1.037	95 ±10°F	0.5 to 3.0 mL per hr of solution

Actual (Pretest)					
				Fallout	
Date	pH	Specific Gravity	Temperature	Receptacle No. 1	Receptacle No. 2
1 Dec 1988	6.9	1.028	96°F	25	70

Actual (Test)					
				Fallout	
Date	pH	Specific Gravity	Temperature	Receptacle No. 1	Receptacle No. 2
2 Dec 1988	6.5	1.026	95°F	25	70
3 Dec 1988	7.1	1.029	95°F	30	50
4 Dec 1988	6.5	1.025	95°F	50	50

7.2.3 Rain Conditioning

Simulated rain conditioning was conducted after completion of the salt spray conditioning. The test article was subjected to a water spray for a minimum of 1 hr. The conditioning was conducted at the Morton Thiokol T-3 test facility and met the following conditions:

Water pressure:	40 psig
Water temperature:	45°F
Chamber temperature:	73°F
Rain duration:	1 hr minimum
Rain droplet size:	2 to 4.5 mm diameter
Distance from nozzle:	19 ±1 in.

7.2.4 Low-Temperature Conditioning

Low-temperature conditioning was conducted after completing the rain conditioning. The test article was towel dried, immediately placed in the Morton Thiokol T-3 test facility, and subjected to a 20° +0-10°F environment for a minimum of 48 hr (Figure 10). Upon completion of this conditioning, the test article was placed in a 75° ±10°F environment for a minimum of 24 hr and allowed to return to ambient conditions. Postinspection of the test article showed salt deposits accumulated in the bottom of the vent valve.

7.3 TEST RESULTS AND DISCUSSION

The vibration/pressurization test was conducted in the Morton Thiokol T-53 shaker facility from 19 Dec 1988 to 6 Jan 1989. Two Ling A340 shakers were used to conduct the test. The longitudinal and tangential axes tests were conducted using a shaker which was configured horizontally and bolted to a shaker plate (Figures 6 and 7). The other shaker was configured vertically for the radial test (Figure 8). Test results (control and response accelerometer power spectral density (PSD) plots and time history plots) are included in Appendix A.

The test setup included an internal pressurization pretest of the test article per paragraph 8.1.2 of CTP-0054. All requirements for air flow (3.2 ±0.5 $in.^3$/sec for 160 sec) and pressure (1.0 +0.5-0 psig) were met. The cartridge check valve (vent valve) performed as designed and relieved the JPS

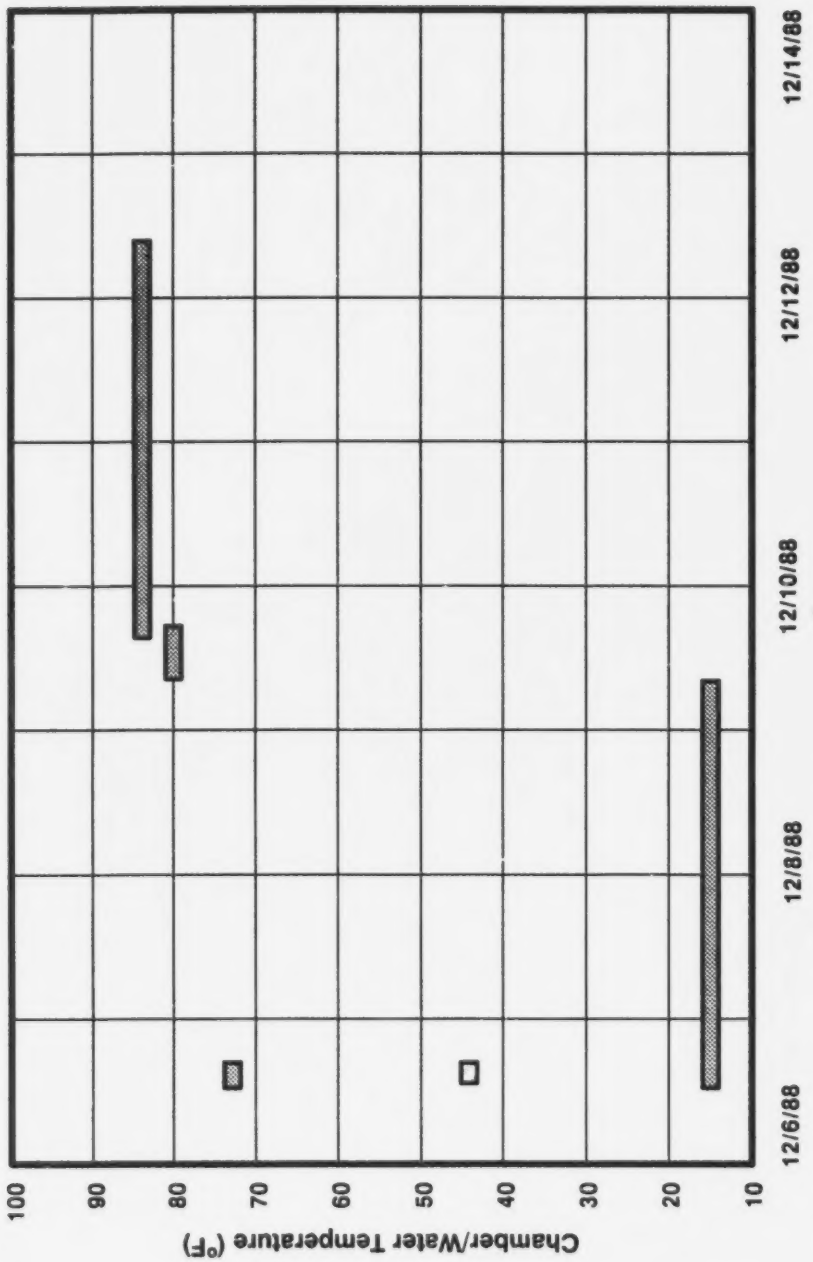

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Figure 10. JPS Test Article Rain and Low Temperature Conditioning—Chamber and Water Temperature

internal pressure during the initial 120 sec (minimum) of each flight random and vehicle dynamics vibration test.

7.3.1 Flight Random Vibration/Pressurization Test

The equipment armature and head expander exhibited a natural resonance in the 1,000-to-2,000-Hz range. Two types of accelerometers were used: control accelerometers which measure motion of the shaker plate, and response accelerometers which measure motion on the test article. Control accelerometer PSD plots show that the test article was subject to motion within tolerances specified by CTP-0054 (Table II). Response accelerometer PSD plots, however, show the equipment resonance as a data spike which exceeds the tolerance criteria of CTP-0054. The resonance/spike was allowed per MIL-STD-810C (Method 514.2, para 4.5.2) and upon receipt of a redline copy of CTP-0054 and a memo from the vice president of Space Operations (Memo A400-FY89-139, included in Appendix B). (The test changes specified in Memo A400-FY89-139 have been incorporated into CTP-0054, Rev. C.) Control and response accelerometer PSD plots are included in Appendix A.

The test article was pressurized (1.0 +0.5-0 psig) during the initial 160 sec of the vibration test. Pressure gages indicated no internal pressure drop throughout this test. Instrumented moisture seal retainer strap clips and links were monitored with a portable data acquisition system to detect any change in strap tension. No change in strap tension was indicated throughout this test. Upon test completion, no visual anomalies on the test article were found. The test article met the requirements of CTP-0054.

7.3.2 Reentry Random Vibration Test

Radial axis test levels could only be met by using two control accelerometers and averaging the two outputs for a solid control. This setup was a result of equipment armature and head expander natural resonance in the 1,000-to-2,000-Hz range. As in the Flight Random Test, control motion was within test criteria, while response motion exhibited a data spike due to equipment resonance. The resonance/spike was allowed per MIL-STD-810C, and per the redline version of CTP-0054 and Memo A400-FY89-139, both included in Appendix B.

Instrumented moisture seal retainer strap clips and links were monitored, and no change in the strap tension was indicated. Upon test completion, no visual anomalies on the test article were found. The test article met the requirements of CTP-0054.

7.3.3 Vehicle Dynamics Vibration/Pressurization Test

The test article was pressurized (1.0 +0.5-0 psig) during the initial 160 sec of the vibration test. Pressure gages indicated no internal pressure drop throughout this test. Instrumented moisture seal retainer strap clips and links were monitored, and no change in the strap tension was indicated. Upon test completion, no visual anomalies on the test article were found. The test article met the requirements of CTP-0054.

7.3.4 Water Impact Shock Test

The test criteria required an impact-simulating, half-sine pulse duration of 0.050 sec. However, the computerized equipment could only give a duration of 0.010 sec. The pulse duration criterion was changed to 0.010 sec per the redline version of CTP-0054 and Memo A400-FY89-139, included in Appendix B. Time history data for the shock tests are included in Appendix A.

Longitudinal axis shock No. 1+ was run with a loose lead on the control accelerometer, and thus the article was over-tested (70.23 g at 100 Hz on the shock spectrum and test criteria peak level at 20 g). Discrepancy Report No. 168169 was written to cover the over-test, and is included in Appendix C. Since no visual damage was done to the test article, the over-test was acceptable. Shock No. 2+ was run to 31.14 g.

Tangential axis shock No. 1+ was run to 19.77 g. (Test criteria peak level was 8 g). The cause of the over-test is unknown. Discrepancy Report No. 168188 was written to cover the over-test, and is included in Appendix C. Since no visual damage was done to the test article, it met or exceeded the test requirements and was acceptable. Shock No. 2+ was run to 16.68 g, No. 1- to 13.49 g, and No. 2- to 13.43 g.

Radial axis shock testing was satisfactory. Shock No. 1- was run to 12.96 g, No. 2- to 12.98 g, No. 1+ to 13.44 g, and No. 2+ to 13.44 g.

7.3.5 Cork Button Pull Tests

Cork button pull testing was conducted on 8 Feb 1989 in the Morton Thiokol M-53 Development Lab (Table 2). Five specimens located on the extruded cork-to-joint fixture bond failed 100 percent in the cork and failed at higher stress than cork tensile dog bone tests (documented in TWR-17230, "Cork Extrusion Mechanical Characterization Final Test Report"). Two other pull test locations (moisture seal-to-cork extrusion bondline and Kevlar® strap and K5NA-to-cork extrusion bondline) also yielded acceptable results.

Table 2. Cork Button Pull Test Results

Specimen No.	Location	Max Load (lb)	Max Stress (psi)	Failure Mode
1	Cork-to-Case Bond	160	133	100% CCF
2		329	275	
3		312	261	
4		288	241	
5		279	233	
6	Moisture Seal-to-Cork Bond	54	45	10% CCF, 90% AFMS
7		97	81	25% CCF, 75% AFMS
8		89	75	
9		106	89	50% CCF, 50% AFMS
10		131	110	70% CCF, 30% AFMS
11	Kevlar® Strap/K5NA-to-Cork Bond	291	243	70% CCF, 30% AFKS
12		124	104	50% CCF, 50% AFKS
13		251	210	
14		218	182	80% CCF, 20% AFKS
15		194	162	

Date: 8 Feb 1989
Temperature: 75°F

Button Diameter: 1.2340 in.
Button Cross Section: 1.196 in.^{2}
Crosshead Speed: 0.5 in./min

CCF: Cohesive cork failure
AFMS: Adhesive failure to moisture seal
AFKS: Adhesive failure to Kevlar® strap/K5NA

A020996a

Appendix A

DATA FROM SRM FJEPS VIBRATION/PRESSURIZATION TEST

MORTON THIOKOL, INC.
Aerospace Group
Support Services

TEST REPORT

TITLE: Field Joint Environmental Protection System Vibration/Pressurization Test

PROJECT: 86302-09-20 **DATE:** 25 January 1989

TEST DATE: 19 December 1988 - 6 January 1989 **REPORT NO.** TR-12773

PREPARED BY: Rick Baird

Rick Baird
Test Engineer

APPROVED BY: Bruce O Tams

Bruce O. Tams, Manager
Test Engineering

DISTRIBUTION:

FORM TC 7155 (REV 10-87)

MORTON THIOKOL
WASATCH OPERATIONS

TABLE OF CONTENTS

1.0	SUMMARY
2.0	TEST RESULTS
3.0	TEST DATA

MORTON THIOKOL, INC.
WASATCH OPERATIONS

1.0 SUMMARY

This report contains the results of the Vibration Testing conducted on the 7U76358 Field Joint Test Assembly. Testing met or exceeded the requirements contained in the CTP-0054 test plan. Testing was run per Shop Travelers 7A052 and 7A053.

2.0 TEST RESULTS

2.1 Test Configuration

The following test tools were used:

2U105664	Vibration Slip Plate
6021ST	Drive Bar
X-M19506-6	Head Expander
7U76358	Test Assembly

2.2 Test Set-Up

The test article was received at T-53 on 12 December 1988. Visual inspection showed rust and corrosion on all exposed metal (non-painted or non-plated). Test article was stored at T-53 til 19 December 1988 when test set-up could be scheduled.

Test set-up included an internal pressurization pre-test per paragraph 8.1.2 of CTP-0054. All requirements for air flow (3.2 +/- .5 in 3/sec for 160 sec) and pressure (1.0 + .5 -0 psig) were met.

Testing was conducted using the Ling A340 shakers. Longitudinal and radial axes were run on the slip plate. Radial axis was run on the vertical shaker.

2.3 Test Performance

2.3.1 Flight Random Vibration

Test was run per requirements listed in CTP-0054 table II Flight Random Vibration. Test article was pressurized during initial 160 seconds visually monitoring pressure gages. FM Tape #22957 contains flight random vibration levels and pressure levels. No visual anomalies were noticed. Article met requirements of Test Plan.

2.3.2 Re-Entry Random

Test was run per requirements listed in CTP-0054 Table II Re-entry Random Vibration. FM Tape #22957 contains the longitudinal and tangential axes data. FM Tape #22959 contains the radial axis data. Article met requirements of test plan. Radial axis test levels could only be met by using two control accelerometers and averaging between their two outputs for a solid control. PSD plots show resonance between 1000-2000 Hz. This is due to armature and Head Expander set-up natural resonance.

2.3.3 Vehicle Dynamics

Test was run per requirement listed in CTP-0054 Table II Vehicle Dynamics Criteria. Test article was pressurized during initial 160 seconds of the vibration. No drop in pressure was seen by visually monitoring pressure gages. FM tape #22958 contains vehicle dynamics data. Article met requirements of test plan.

2.3.4 SRM Water Impact Shock

Test was run per requirements listed in CTP-0054 Table II under SRM Water Impact Shock Criteria.

Test criteria required a duration of .050 seconds. Computerized equipment can only give a duration of .010 seconds. Traveler was changed to .010 seconds upon receipt of a "red-lined" test plan and memo from J. D. Thirkill.

Longitudinal axis shock #1 was run with a loose lead on the control accelerometer and thus an overtest level of 70.23 G's was seen. DR #168169 was written to cover this. Disposition was that data was acceptable.

Tangential axis shock was run to a 19,77G level. Cause was unknown. DR #168188 was written and dispositioned that data was acceptable.

2.3.5 Test Monitoring of Clip Gages

During the Flight Random, Re-entry and Vehicle Dynamics Vibration, Clip Gages were monitored by C/C 5618. This consisted of a PDAS set-up to monitor "clip-gages". The clip gages were installed on the straps during Field Joint Build-up. No loosening or change in the straps was noticed during testing.

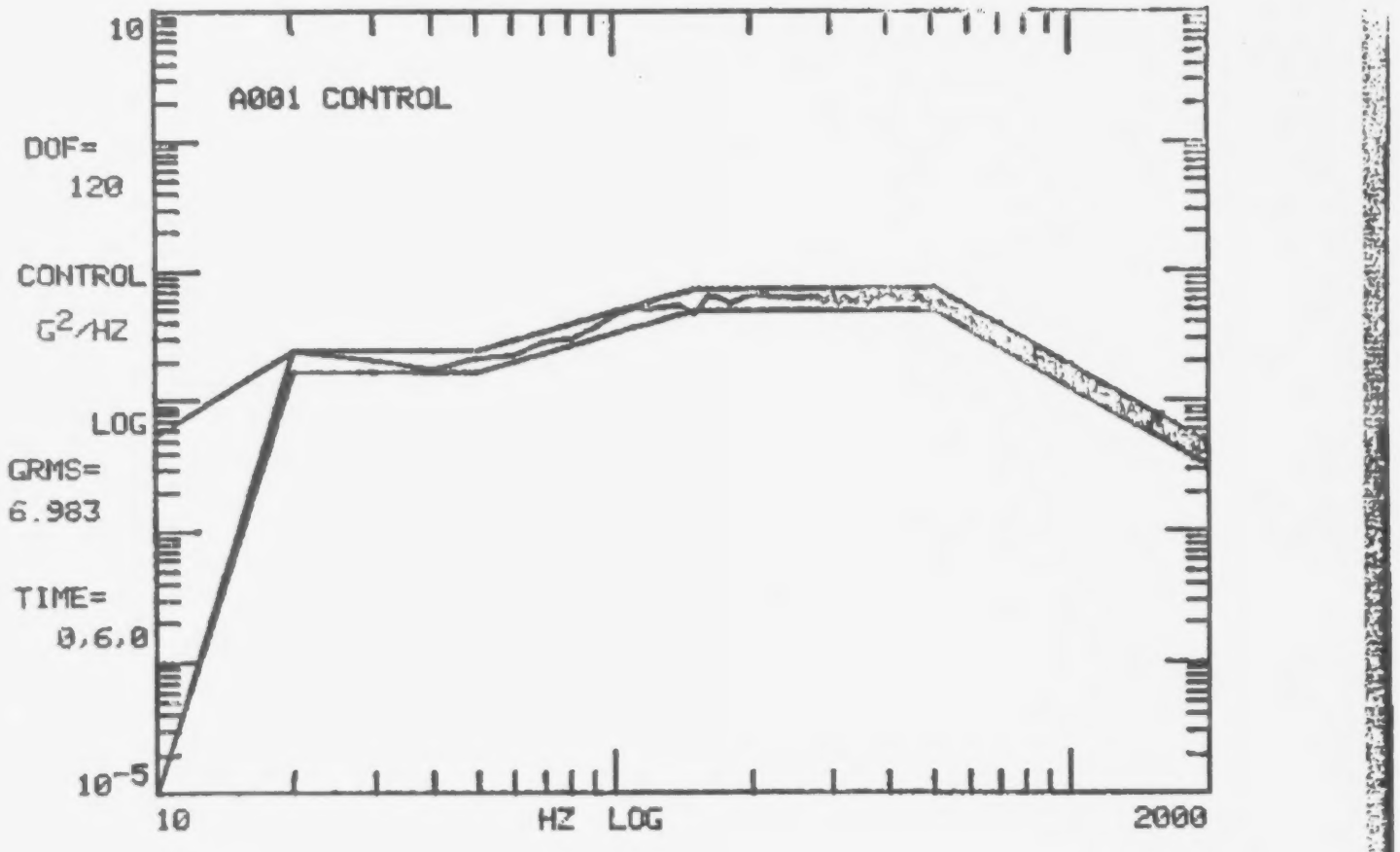
2.3.6 Post Test

Post test inspection showed no visual anomalies to the test article.

3.0 TEST DATA

A. Photographs

B. PSD Plots



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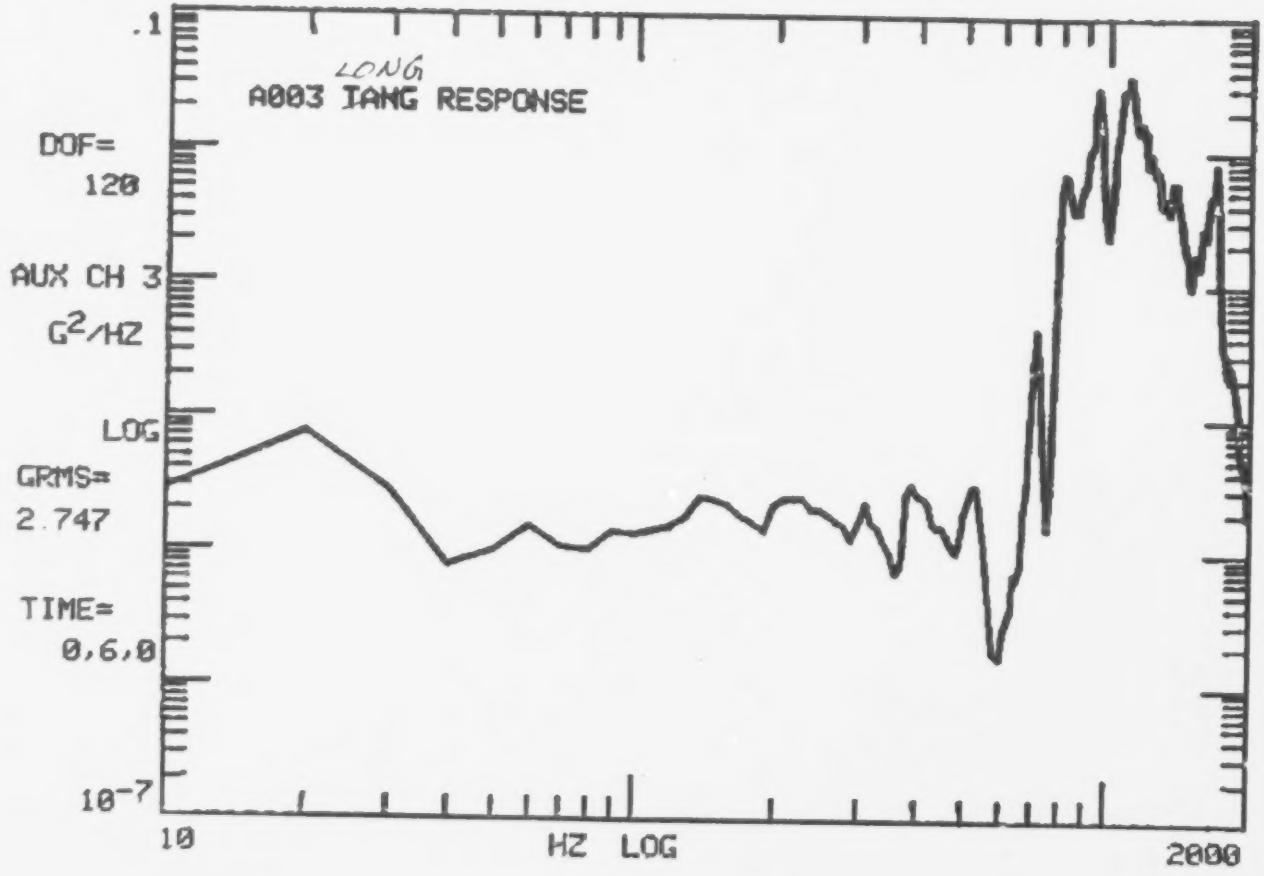
FJEPS RANDOM TANG AXIS 19-DEC-88

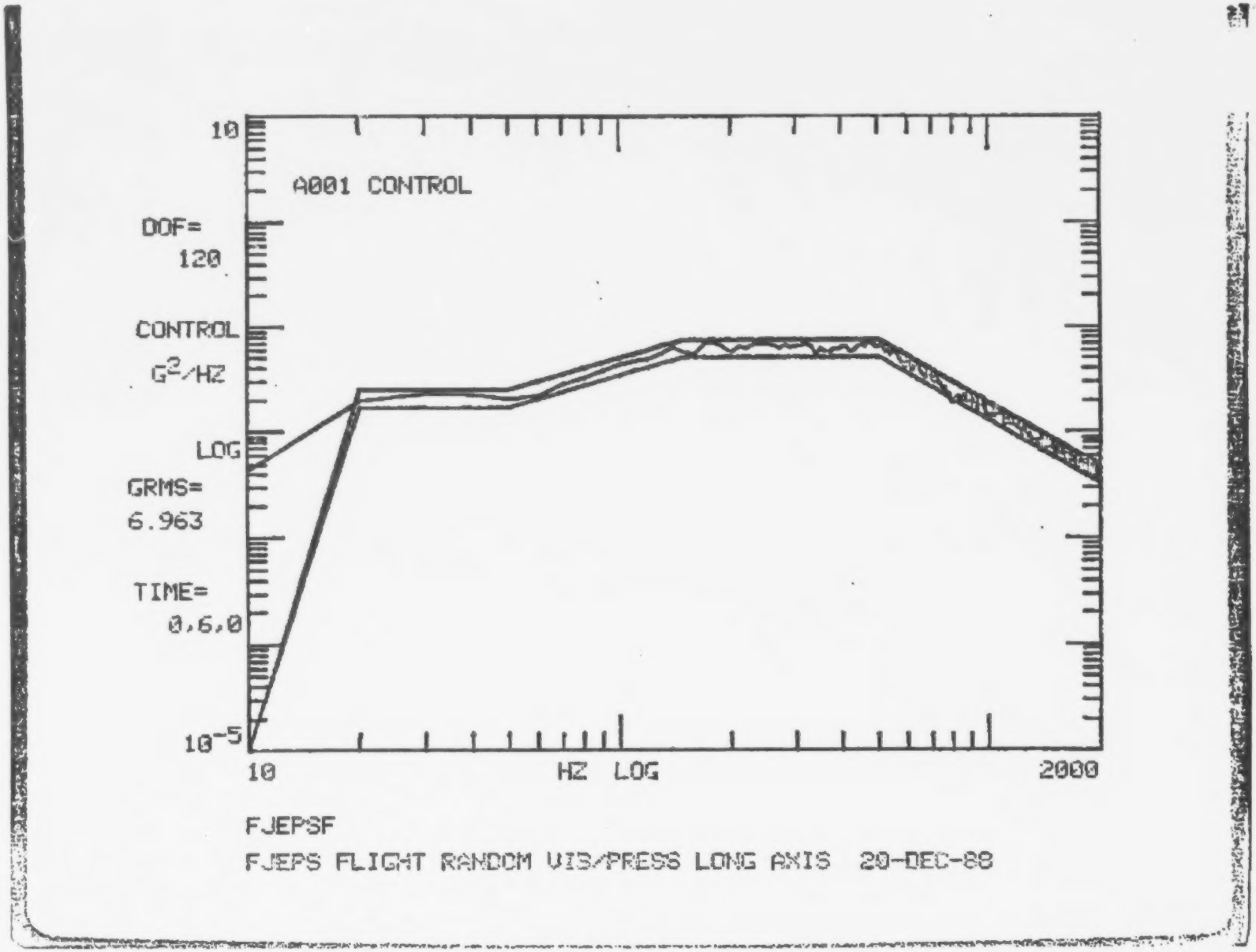
FLIGHT



FJEPSC

FJEPS RANDOM LONG AMES 19-DEC-89

FLIGHT


10
A001 CONTROL
DOF=
120
CONTROL
G²/HZ
LOG
GRMS=
6.963
TIME=
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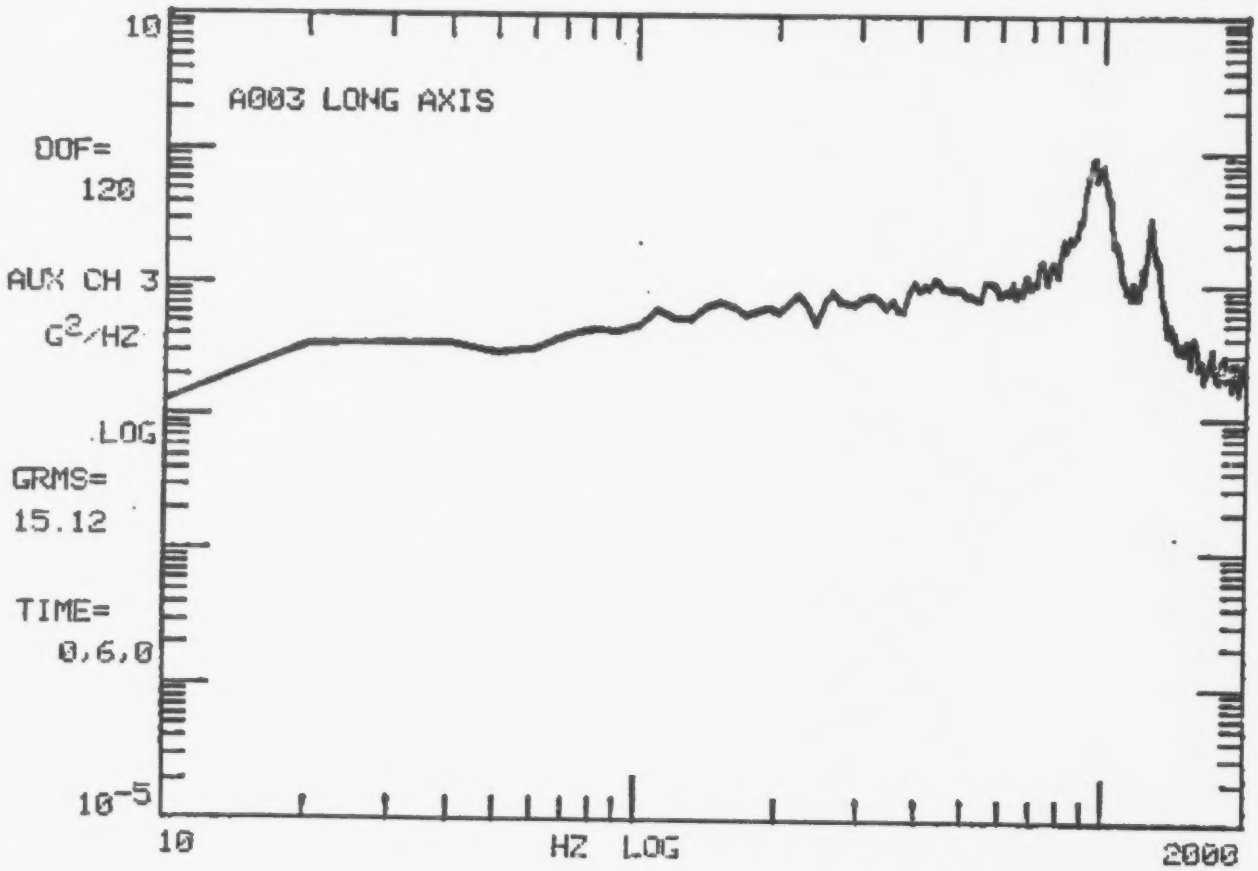
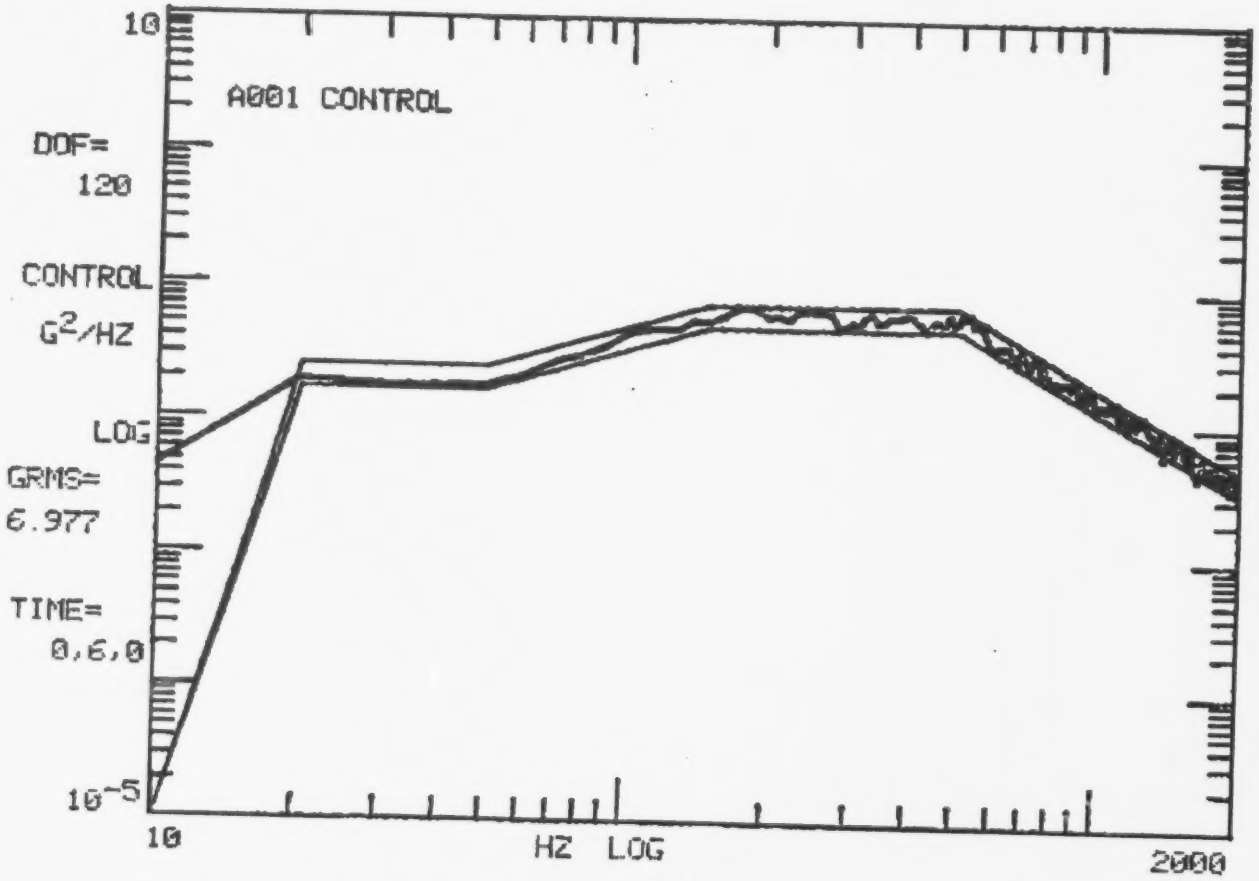
10⁻⁵
10
HZ LOG
2000
FJEPSF
FJEPS FLIGHT RANDOM VIB/PRESS LONG AXIS 20-DEC-88



FJEPSF

FJEPS FLIGHT RANDOM VIB/PRESS LONG AXIS 28-DEC-88



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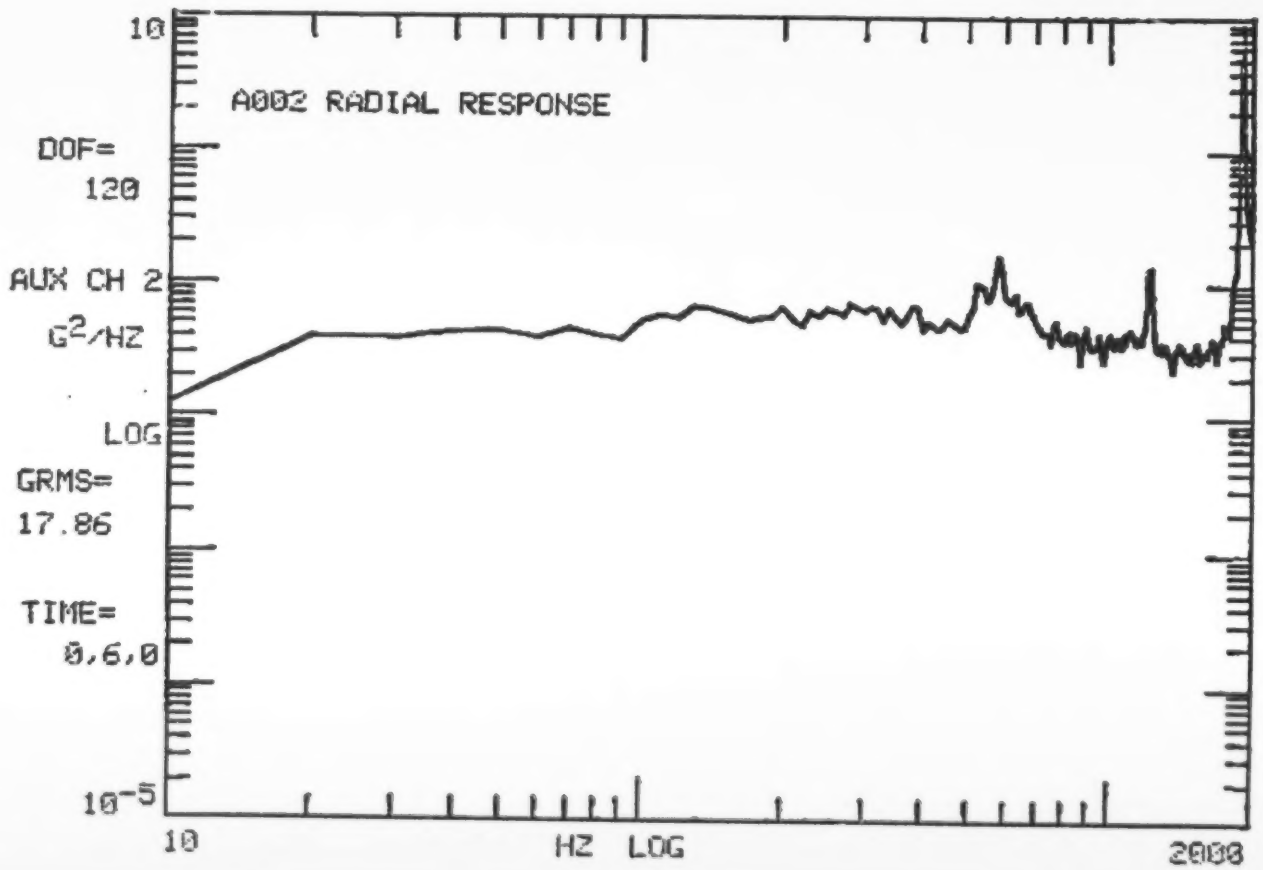

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FJEPS FLIGHT RANDOM VIB/PRESS RADIAL AXIS 20-DEC-88

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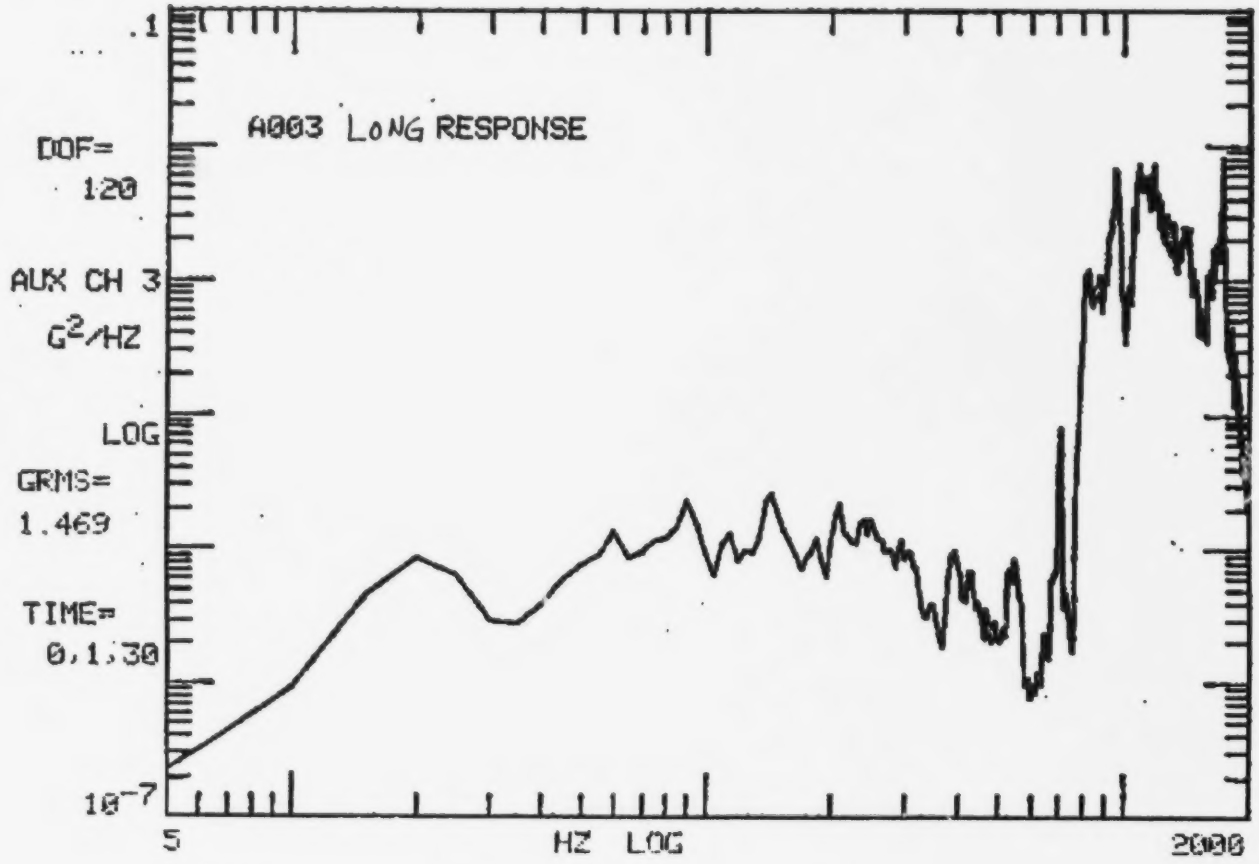
FJEPS RE-ENTRY RANDOM, TANGENTIAL AXIS, 23-DEC-88



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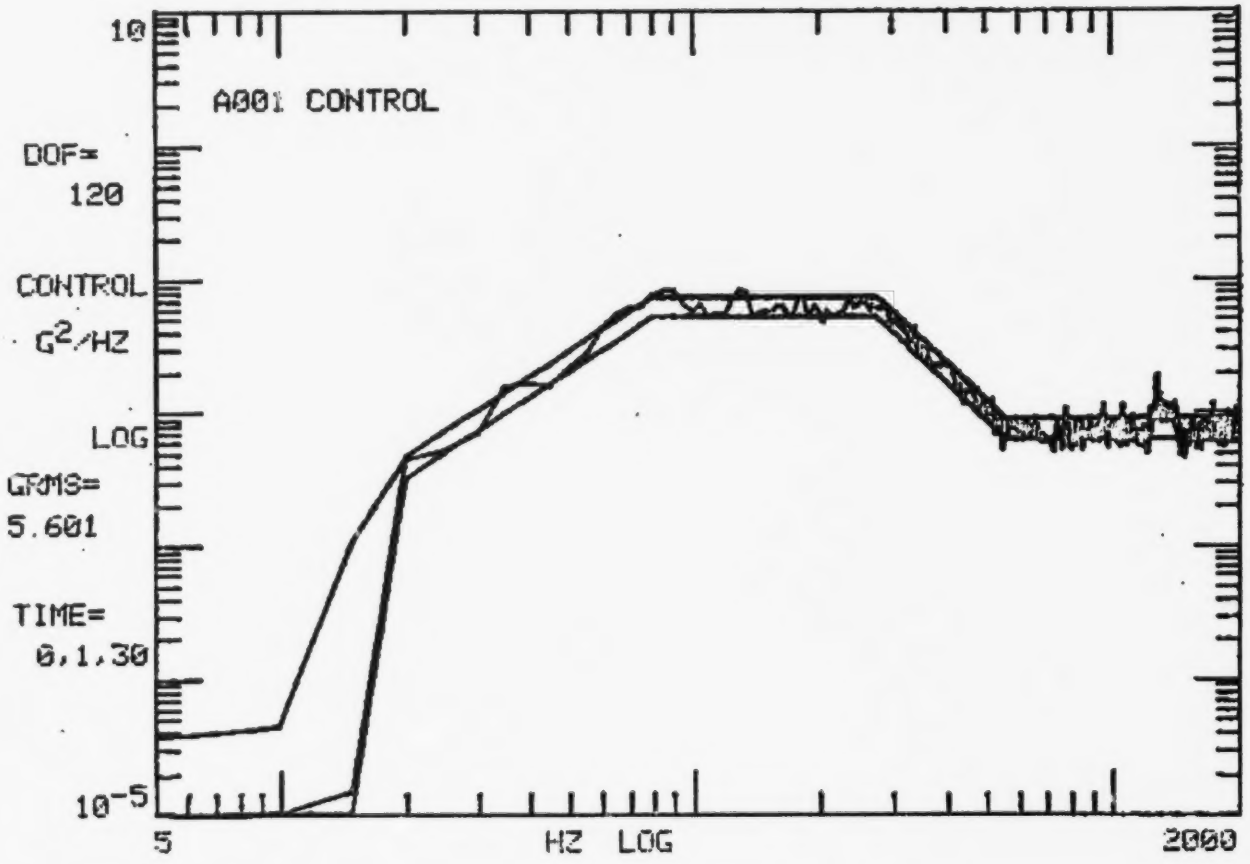

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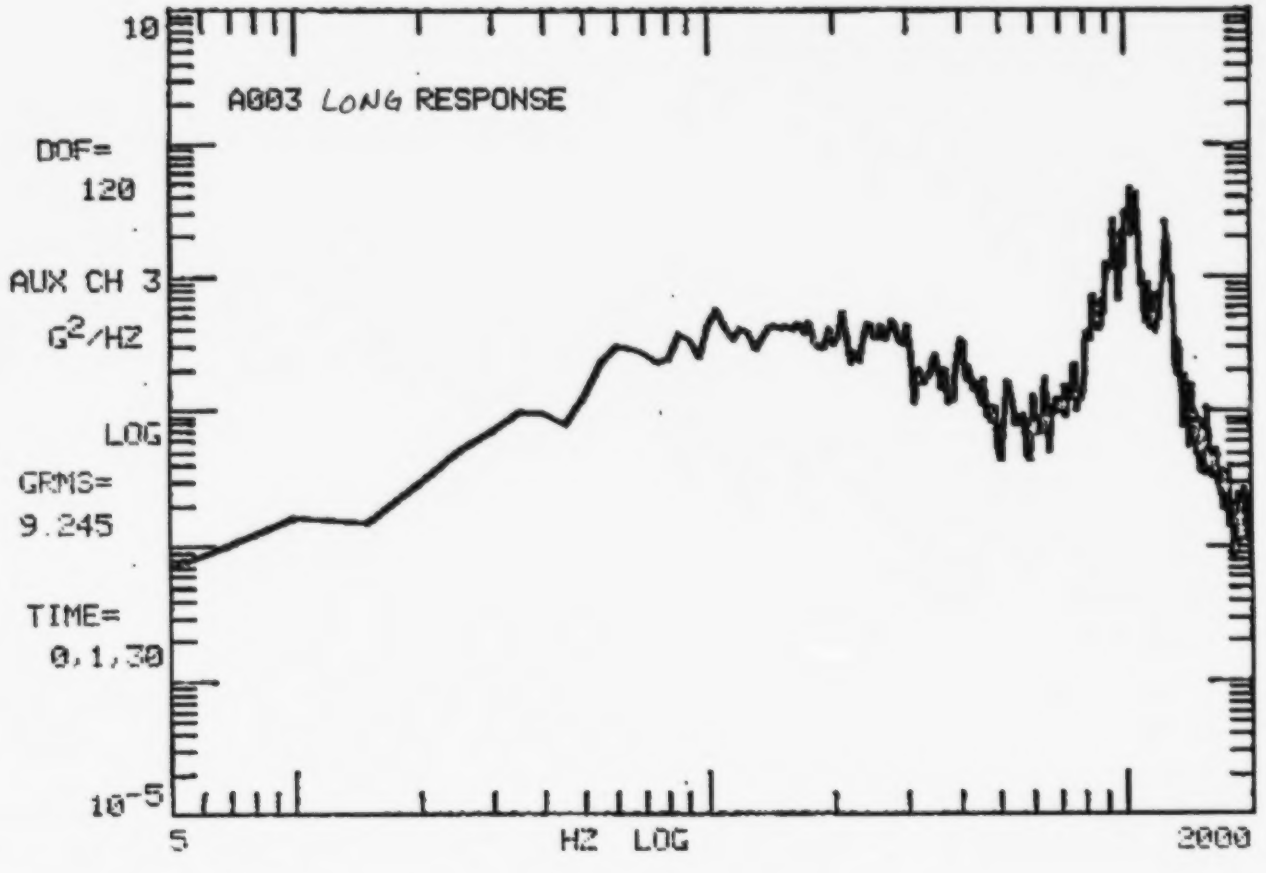

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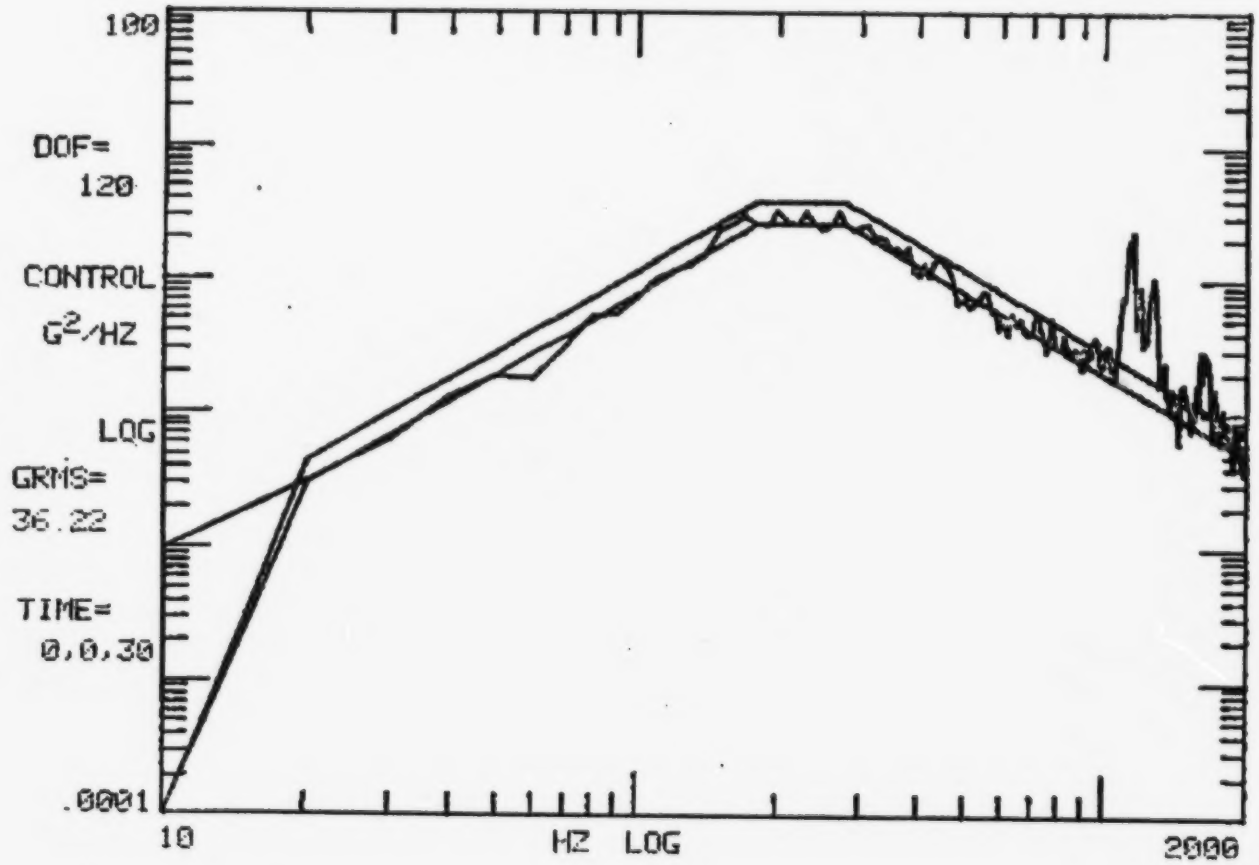

FJEPSJ

FJEPS RE-ENTRY RANDOM VIB., RADIAL AXIS, 22-DEC-88

FJEPSJ

FJEPS RE-ENTRY RANDOM VIB., RADIAL AXIS, 22-DEC-88

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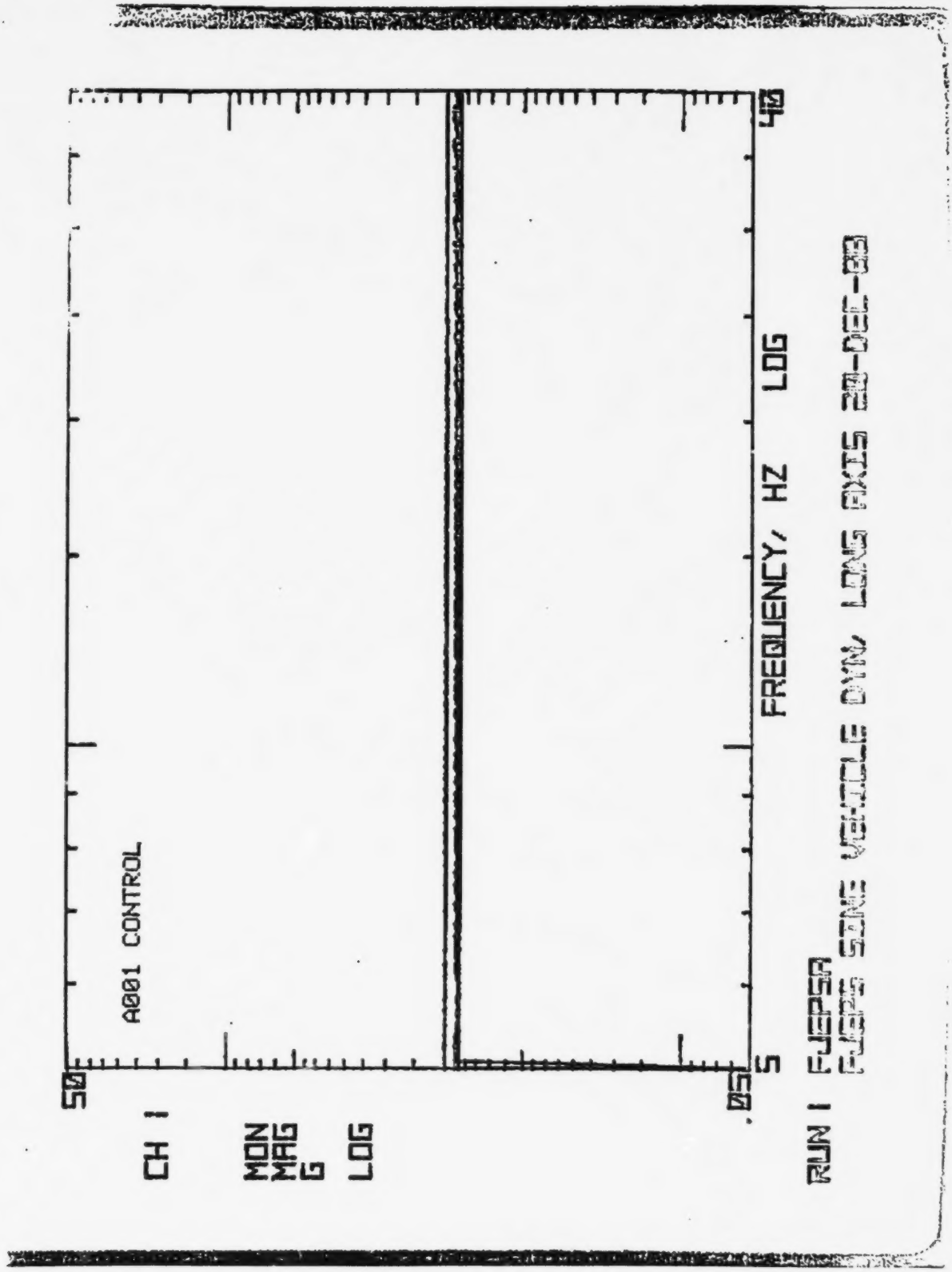

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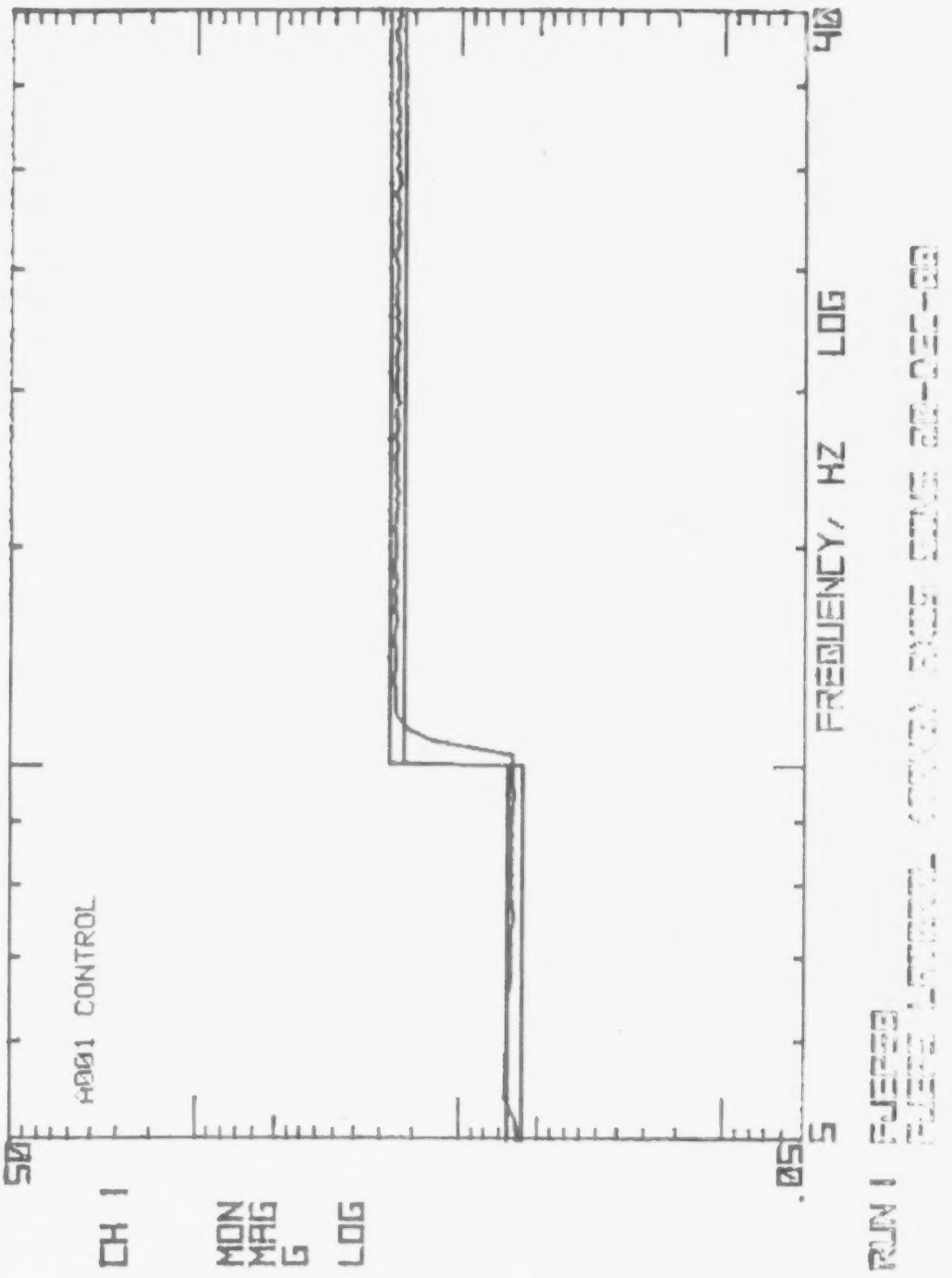

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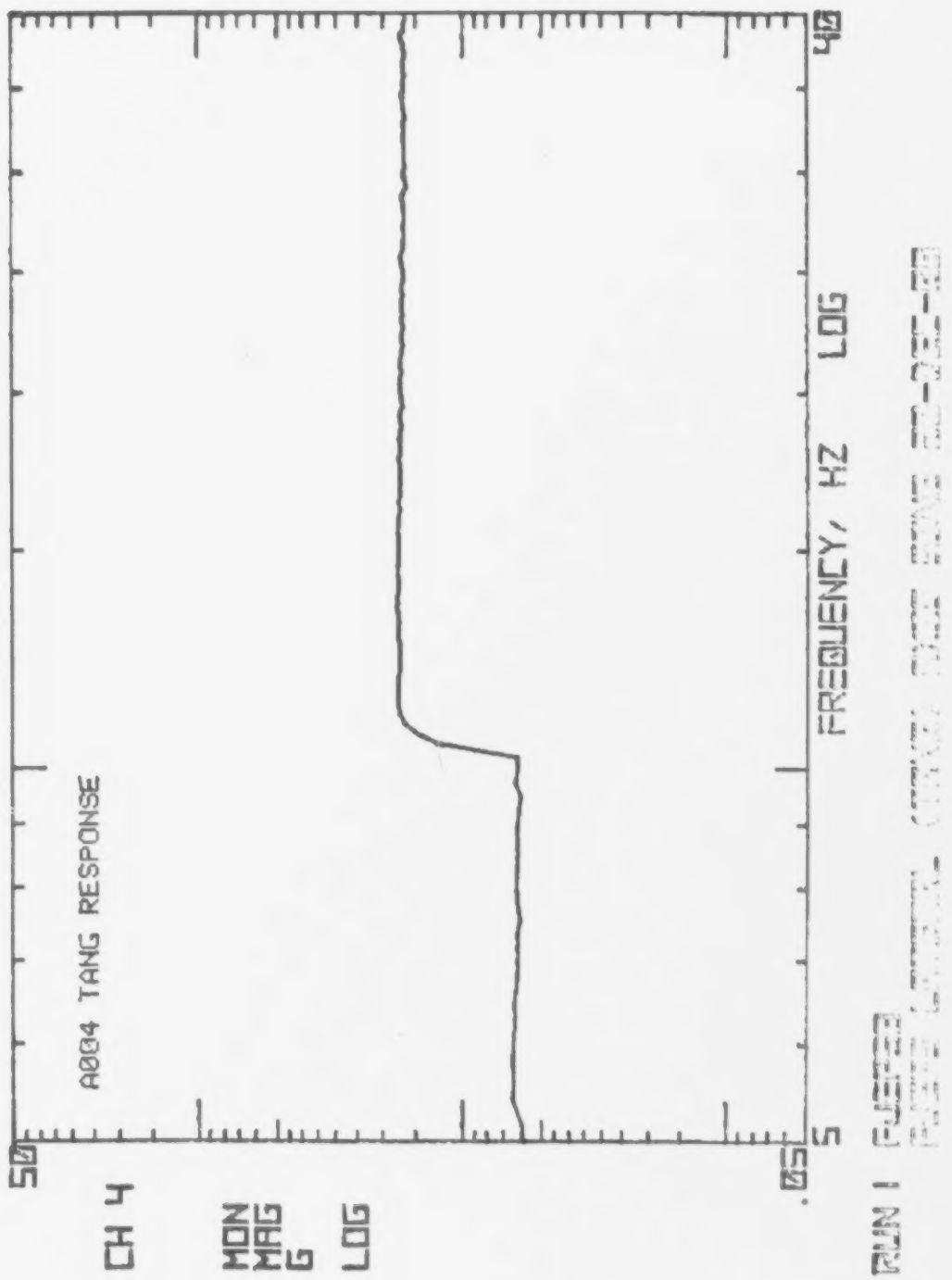

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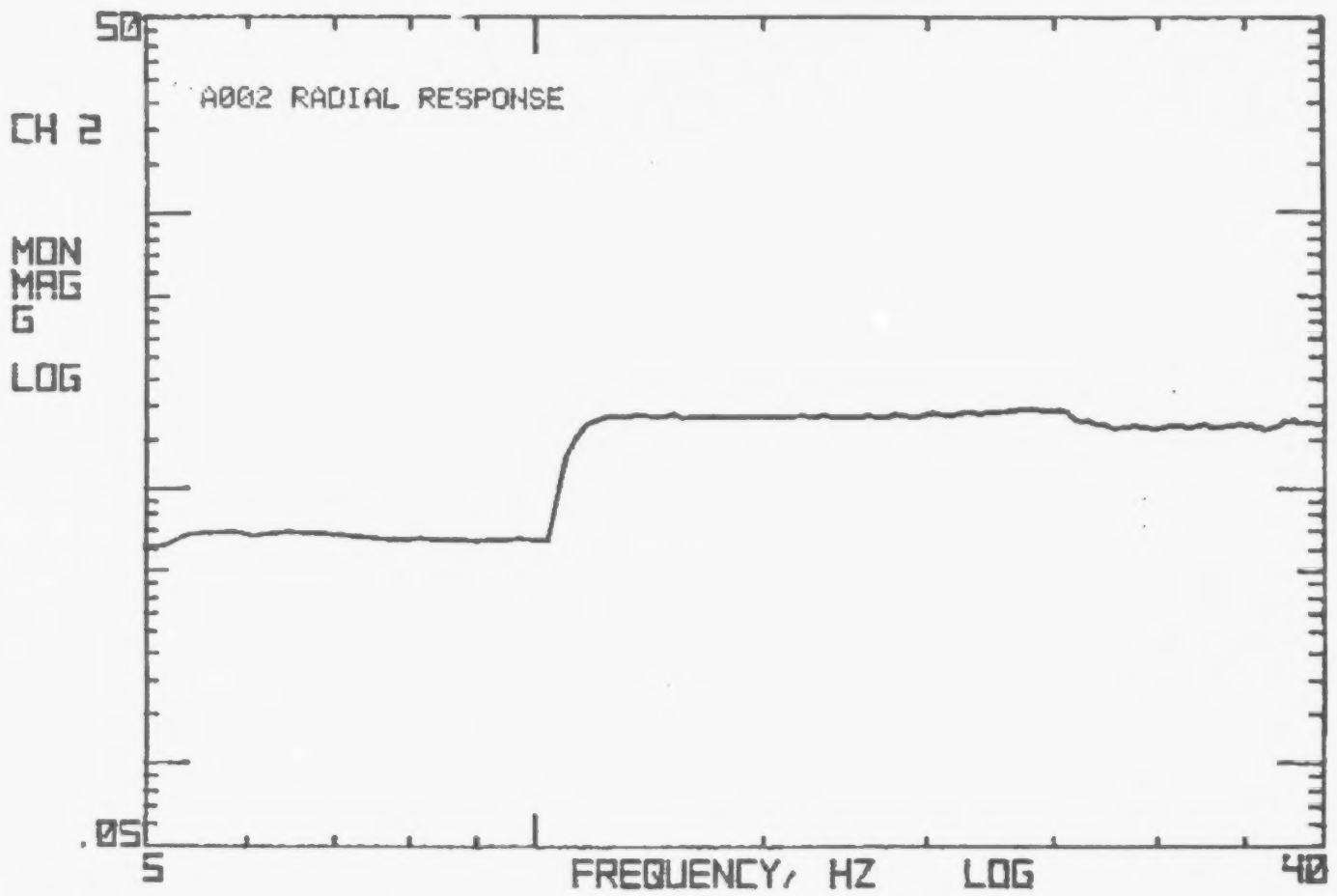
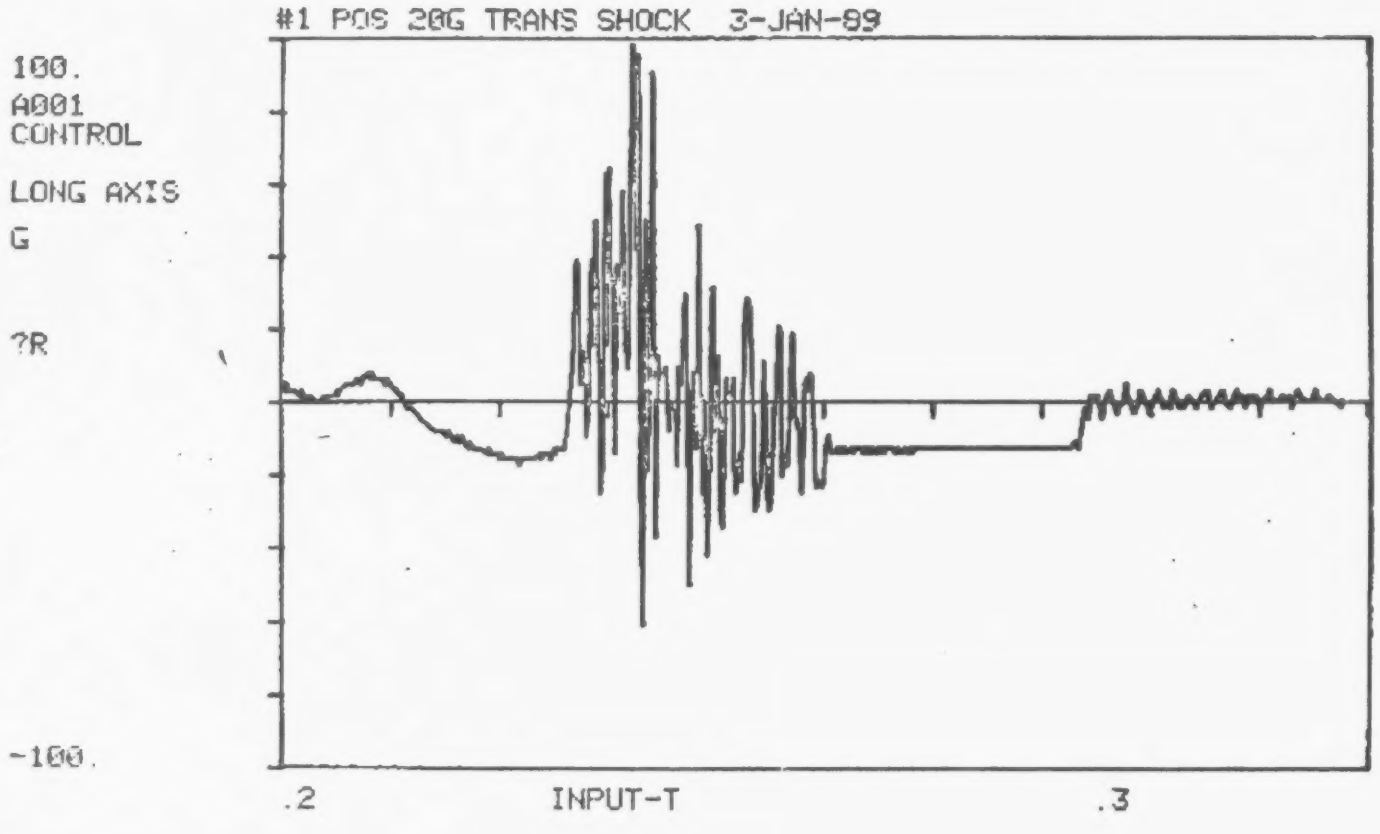


RUN 3 FJEPSC
FJEPS LATERAL (RADIAL) AXIS SINE 20-DEC-88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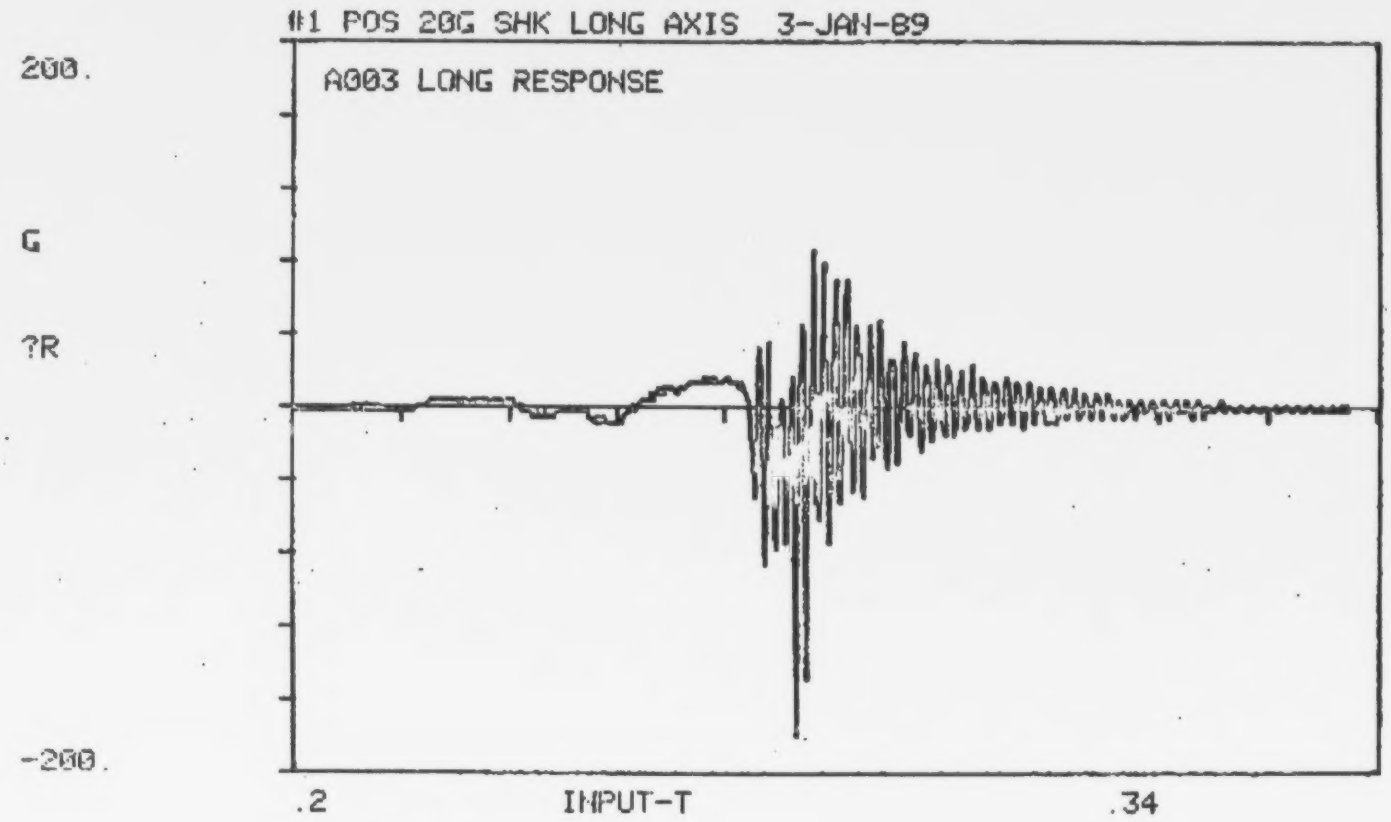
100.
A001
CONTROL
LONG AXIS
G
?R
-100.
.2
INPUT-T
.3

SHOCK SPECTRUM VALUES: SRM F.J.E.P.S. 3-JAN-09

FREQ-HZ	MAGN-G
1.	1.32
1.121	1.585
1.259	1.703
1.412	2.155
1.584	2.421
1.778	2.741
1.995	3.205
2.238	3.473
2.512	3.931
2.818	4.284
3.162	4.84
3.547	5.381
3.98	6.043
4.467	6.912
5.011	7.847
5.623	8.968
6.309	10.03
7.078	11.11
7.941	12.81
8.912	15.68
10.	19.39
11.21	23.48
12.58	28.39
14.12	32.63
15.84	35.61
17.78	41.25
19.95	45.26
22.38	47.04
25.11	60.
28.17	77.98
31.62	84.97
35.48	88.88
39.81	86.76
44.65	85.17
50.1	72.85
56.22	79.47
63.08	81.25
70.8	65.48
79.42	74.24
89.11	65.87
100.	70.23
112.1	39.8
125.8	49.62
141.2	62.26
158.4	62.7
177.8	79.57
199.5	90.56
223.9	94.42
251.1	74.61
281.8	68.61
316.3	78.74
354.7	141.
398.1	111.9
446.7	172.8
501.2	218.4
562.5	253.4
630.9	290.5
708.1	419.6
794.1	281.2
891.3	243.1
1000.	200.1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A003 LONG RESPONSE
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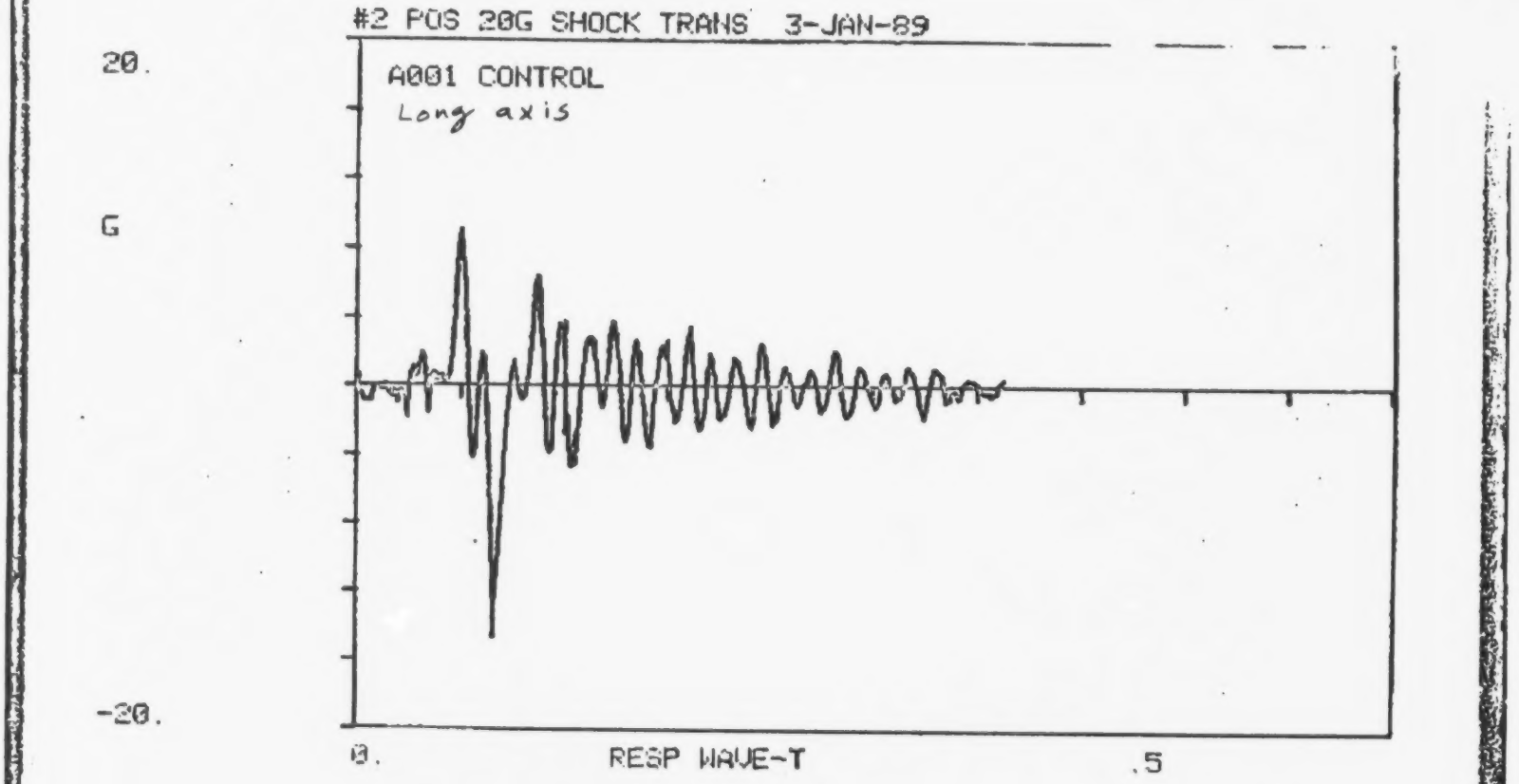
G
?R
-200.
.2
INPUT-T
.34


#2 POS 20G SHOCK TRANS 3-JAN-89
A001 CONTROL
Long axis
20.
G
-20.
0.
RESP WAVE-T
.5

SHOCK SPECTRUM VALUES: FJEPS 20G TRANS SHOCK 3-JAN-89

FREQ-HZ	MAGN-G
5.011	.6871
5.623	.874
6.309	1.11
7.078	1.406
7.941	1.767
8.912	2.32
10.	3.098
11.21	4.279
12.58	5.377
14.12	7.127
15.84	8.898
17.78	10.45
19.95	11.81
22.38	13.51
25.11	15.18
28.17	17.37
31.62	17.43
35.48	16.98
39.81	16.45
44.65	14.85
50.1	12.55
56.22	13.74
63.08	14.94
70.8	21.38
79.42	30.02
89.11	32.38
100.	31.14
112.1	24.28
125.8	18.06
141.2	13.95
158.4	14.13
177.8	13.18
199.5	13.18
223.9	13.23
251.1	13.05
281.8	13.11
316.3	13.41
354.7	12.72
398.1	12.92
446.7	13.2
501.2	13.44
562.5	13.38
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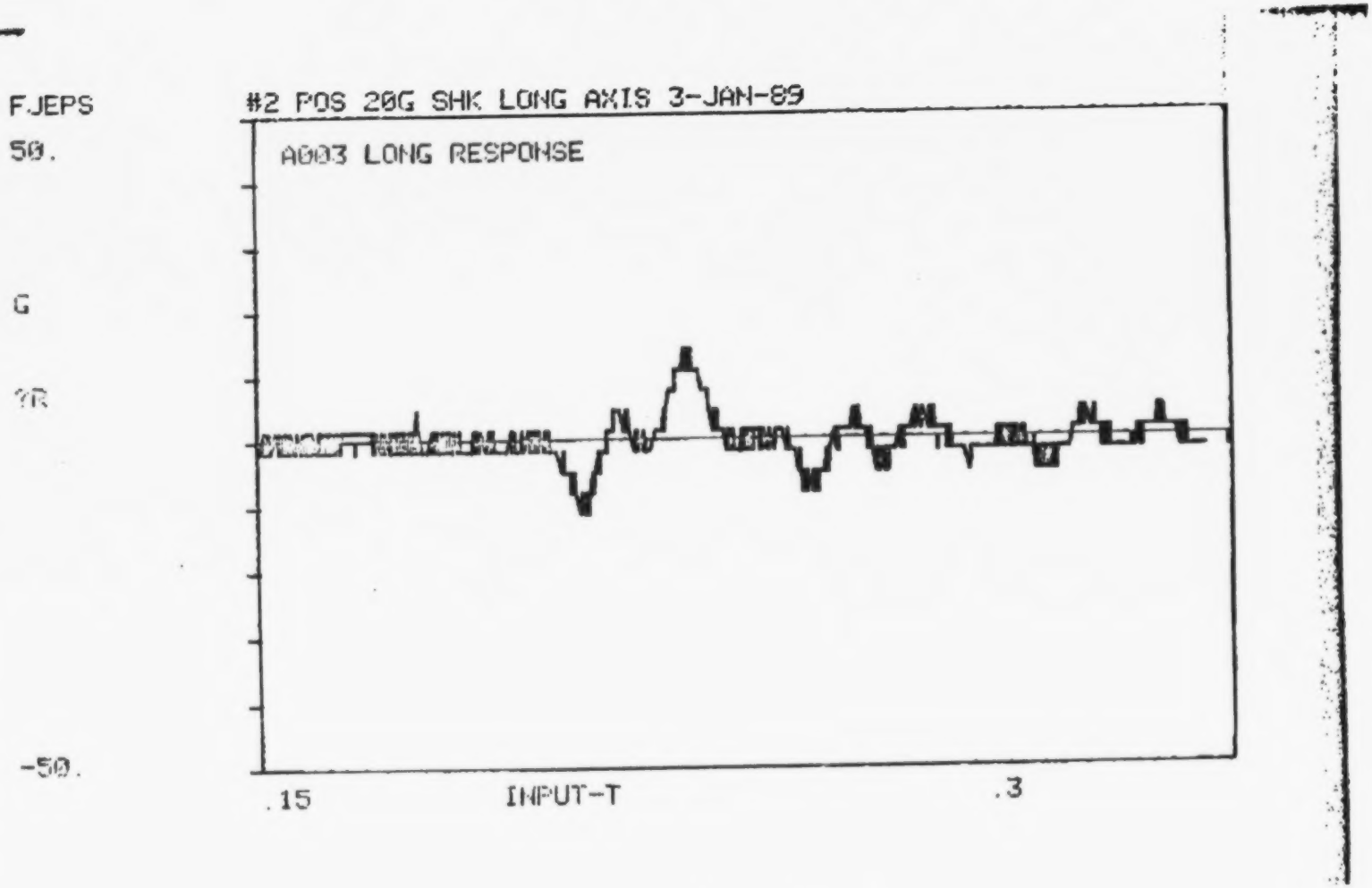
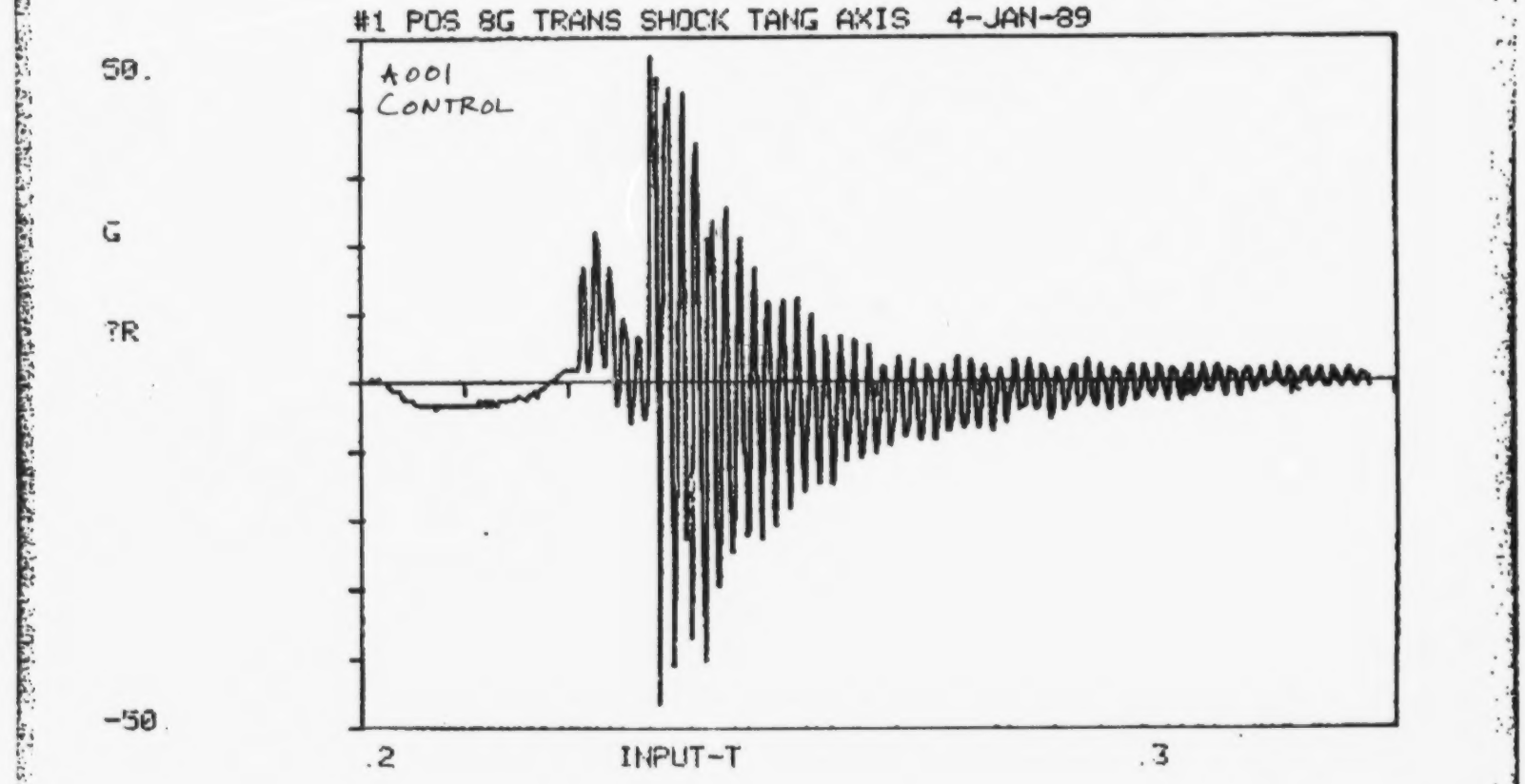
708.1	13.48
794.1	13.
891.3	13.01
1000.	13.28


FJEPS
#2 POS 20G SHK LONG AXIS 3-JAN-89
A003 LONG RESPONSE
50.
G
-50.
.15
INPUT-T
.3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A001
CONTROL
50.
G
?R
-50.
.2
INPUT-T
.3

SHOCK SPECTRUM VALUES: FJEPS SG SHOCK 4-JAN-89

FREQ-HZ	MAGN-G
1.	.09531
1.121	.1196
1.259	.1541
1.412	.1629
1.584	.1815
1.778	.2117
1.995	.2462
2.238	.2767
2.512	.3174
2.818	.3664
3.162	.4085
3.547	.4706
3.98	.5539
4.467	.6724
5.011	.8281
5.623	1.056
6.309	1.359
7.078	1.778
7.941	2.353
8.912	3.151
10.	4.166
11.21	5.42
12.58	6.944
14.12	8.75
15.84	10.78
17.78	13.01
19.95	15.23
22.38	17.42
25.11	19.53
28.17	21.22
31.62	21.17
35.48	21.54
39.81	20.8
44.65	18.88
50.1	16.31
56.22	13.6
63.08	13.25
70.8	14.05
79.42	16.1
89.11	17.47
→ 100.	19.77
112.1	26.14
125.8	30.98
141.2	38.92
158.4	43.83
177.8	45.09
199.5	39.19
223.9	35.6
251.1	35.47
281.8	41.39
316.3	50.63
354.7	54.92
398.1	59.53
446.7	64.2
501.2	70.17
562.5	106.6
630.9	163.6
708.1	255.1
794.1	143.7
891.3	117.8
1000.	98.86

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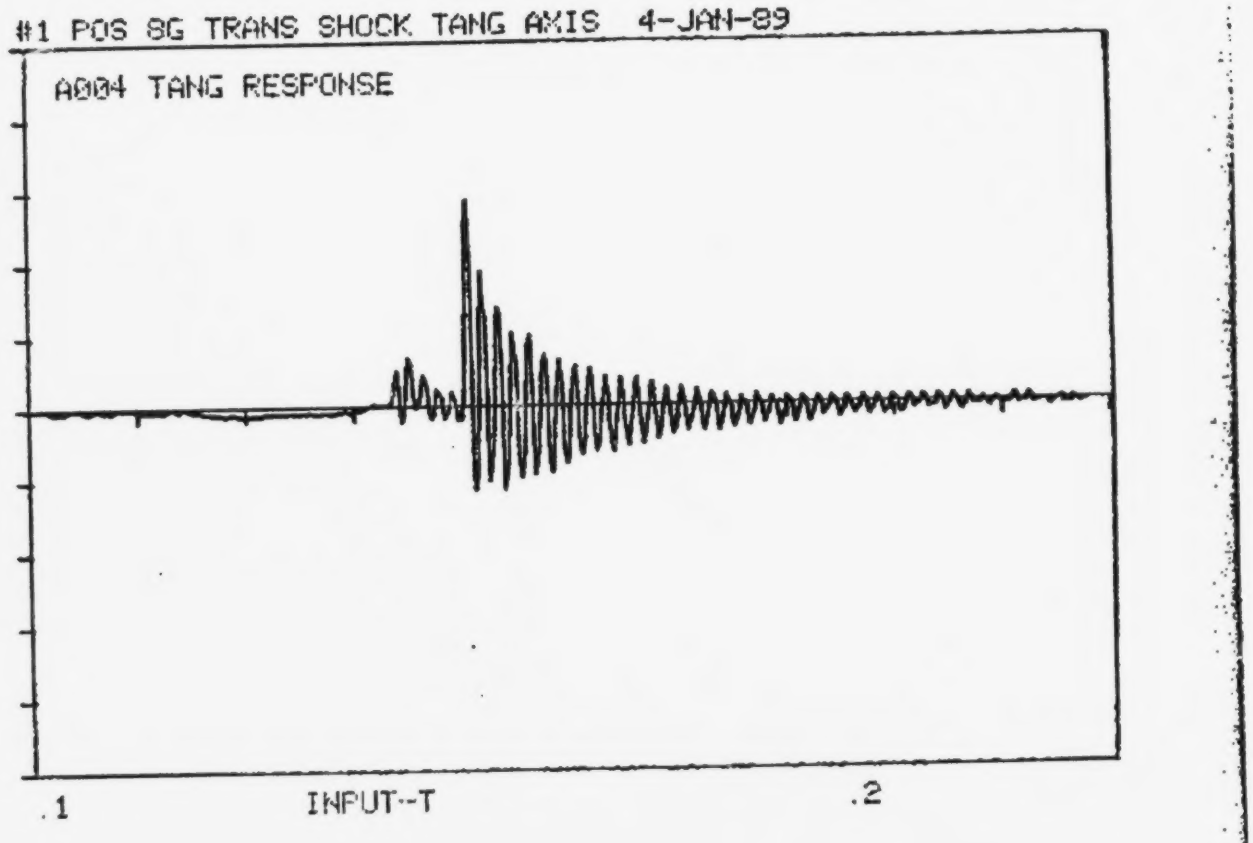
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A004 TANG RESPONSE
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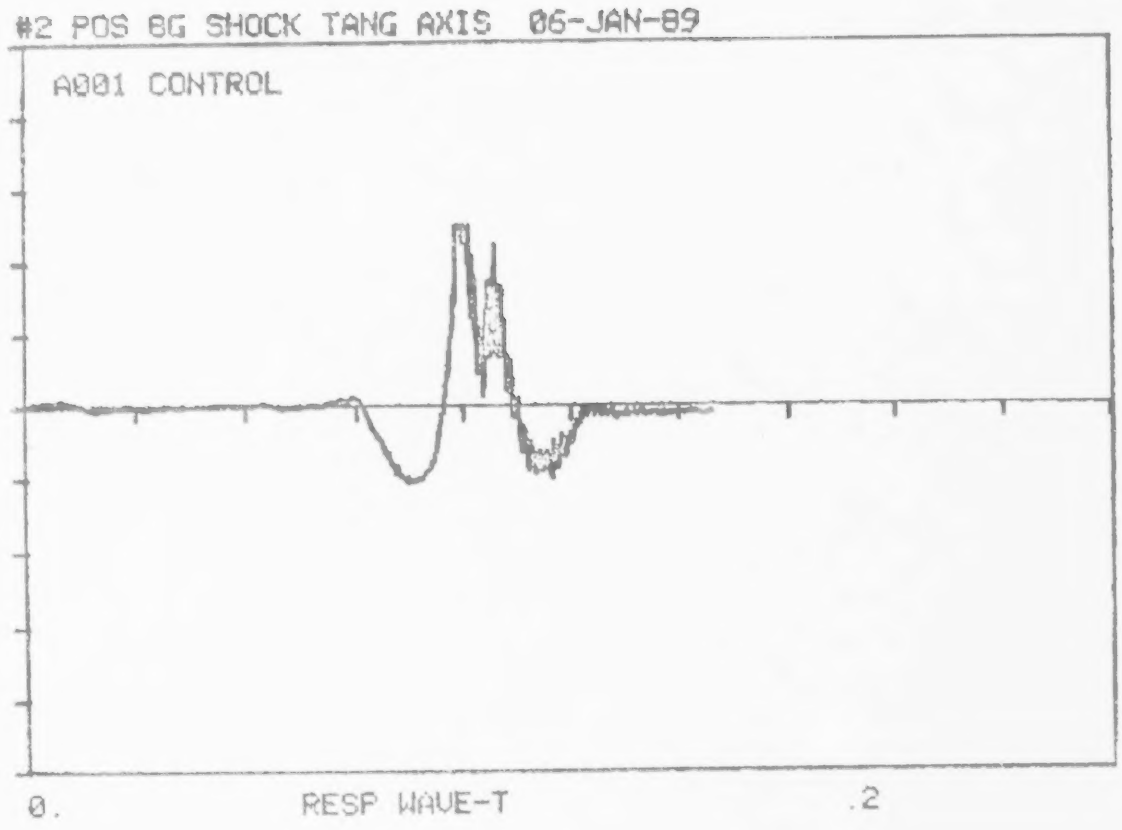
G
?R
-200.
.1
INPUT--T
.2


#2 POS 8G SHOCK TANG AXIS 06-JAN-89
A001 CONTROL
20.
G
-20.
0.
RESP WAVE-T
.2

SHOCK SPECTRUM VALUES: FJEPS 8G TRANS SHOCK 06-JAN-89

FREQ-HZ	MAGN-G
12.58	2.616
14.12	3.433
15.84	4.445
17.78	5.749
19.95	7.468
22.38	9.517
25.11	11.85
28.17	14.14
31.62	16.41
35.48	18.75
39.81	19.83
44.65	18.96
50.1	18.52
56.22	18.14
63.08	17.1
70.8	15.61
79.42	15.95
89.11	16.12
100.	16.68
112.1	15.92
125.8	15.12
141.2	15.19
158.4	14.58
177.8	13.69
199.5	13.52
223.9	13.15
251.1	13.12
281.8	13.27
316.3	12.82
354.7	12.63
398.1	12.72
446.7	13.1
501.2	13.44
562.5	13.34
630.9	12.87
708.1	12.48
794.1	12.83
891.3	13.06
1000.	13
1122.	12.81
1259.	12.93
1412.	12.88
1584.	18.84
1778.	17.4
1994.	12.03
2238.	12.15
2511.	12.18

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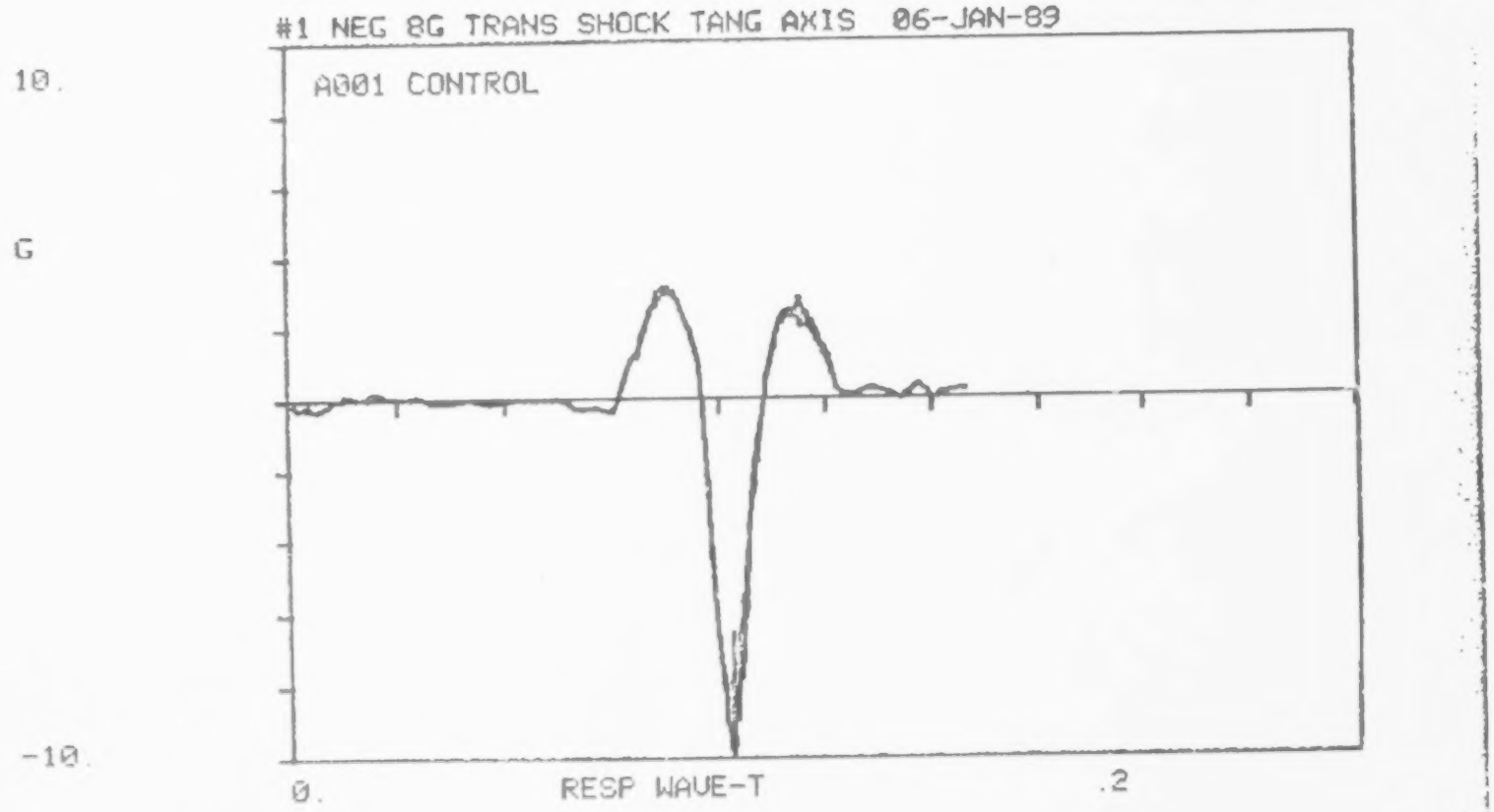
#1 NEG 8G TRANS SHOCK TANG AXIS 06-JAN-89
A001 CONTROL
10.
G
-10.
0.
RESP WAVE-T
.2

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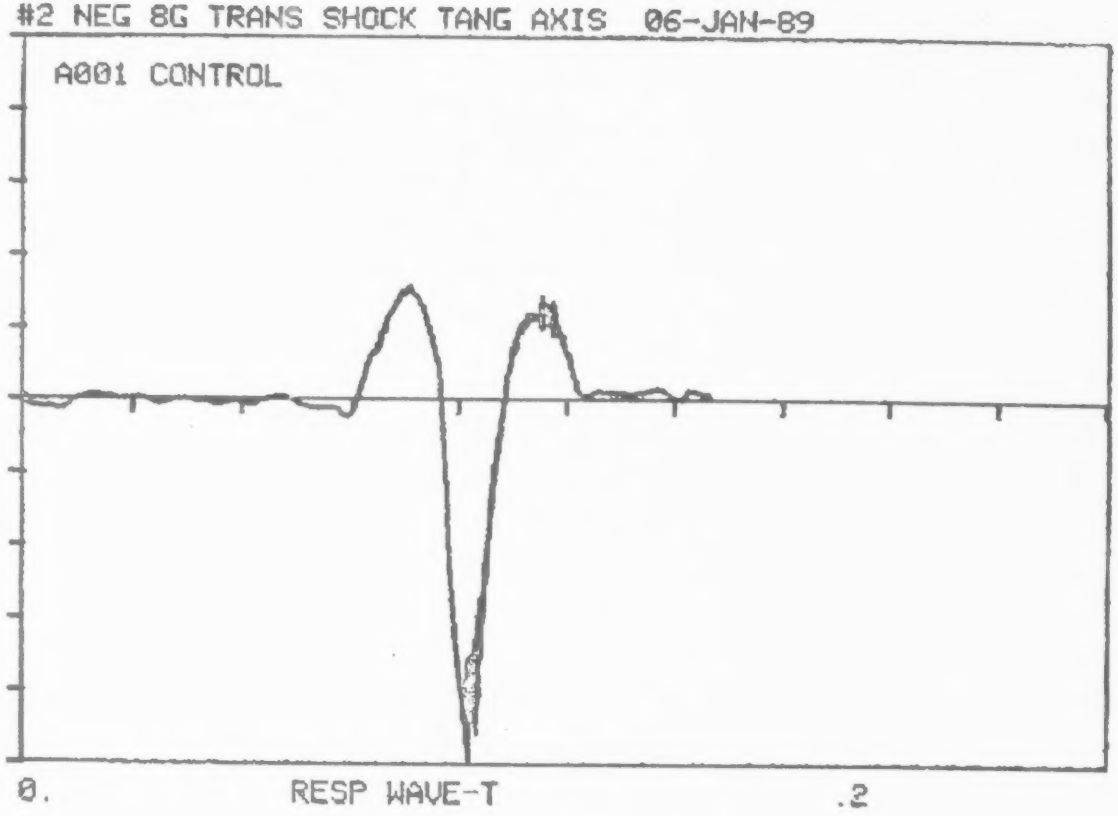
074

SHOCK SPECTRUM VALUES: FJEPS 8G TRANS SHOCK 06-JAN-89

FREQ-HZ	MAGN-G
12.58	2.293
14.12	2.988
15.84	3.872
17.78	4.987
19.95	6.467
22.38	8.19
25.11	10.25
28.17	12.35
31.62	14.58
35.48	16.86
39.81	18.13
44.65	18.16
50.1	17.46
56.22	15.84
63.08	14.94
70.8	13.75
79.42	13.61
89.11	13.77
100.	13.49
112.1	12.8
125.8	12.16
141.2	12.03
158.4	11.01
177.8	9.92
199.5	9.478
223.9	8.914
251.1	8.253
281.8	8.747
315.3	9.515
354.7	9.194
398.	9.176
446.8	8.852
501.2	9.062
562.5	9.824
630.9	8.953
708.1	8.942
794.1	9.032
891.3	9.87
1000.	9.114
1122.	9.115
1259.	9.191
1412.	9.84
1584.	9.848
1778.	10.31
1994.	11.17
2238.	
2511.	


#2 NEG 8G TRANS SHOCK TANG AXIS 06-JAN-89
A001 CONTROL
10.
G
-10.
0.
RESP WAVE-T
.2

SHOCK SPECTRUM VALUES: FJEPS 8G TRANS SHOCK 06-JAN-89

FREQ-HZ	MAGN-G
12.58	2.287
14.12	2.989
15.84	3.885
17.78	5.004
19.95	6.466
22.38	8.172
25.11	10.24
28.17	12.34
31.62	14.56
35.48	16.83
39.81	18.12
44.65	18.12
50.1	17.42
56.22	15.71
63.08	14.89
70.8	13.72
79.42	13.78
89.11	13.8
→ 100.	13.43
112.1	12.1
125.8	11.79
141.2	11.79
158.4	10.8
177.8	9.849
199.5	9.379
223.9	8.781
251.1	9.173
281.8	9.594
316.3	9.409
354.7	9.047
398.1	8.759
446.7	9.062
501.2	9.028
562.5	8.713
630.9	8.91
708.1	8.93
794.1	8.881
891.3	8.85
1000.	8.916
1122.	8.985
1259.	9.003
1412.	9.054
1584.	9.073
1778.	9.069
1994.	9.557
2238.	10.6
2511.	11.15

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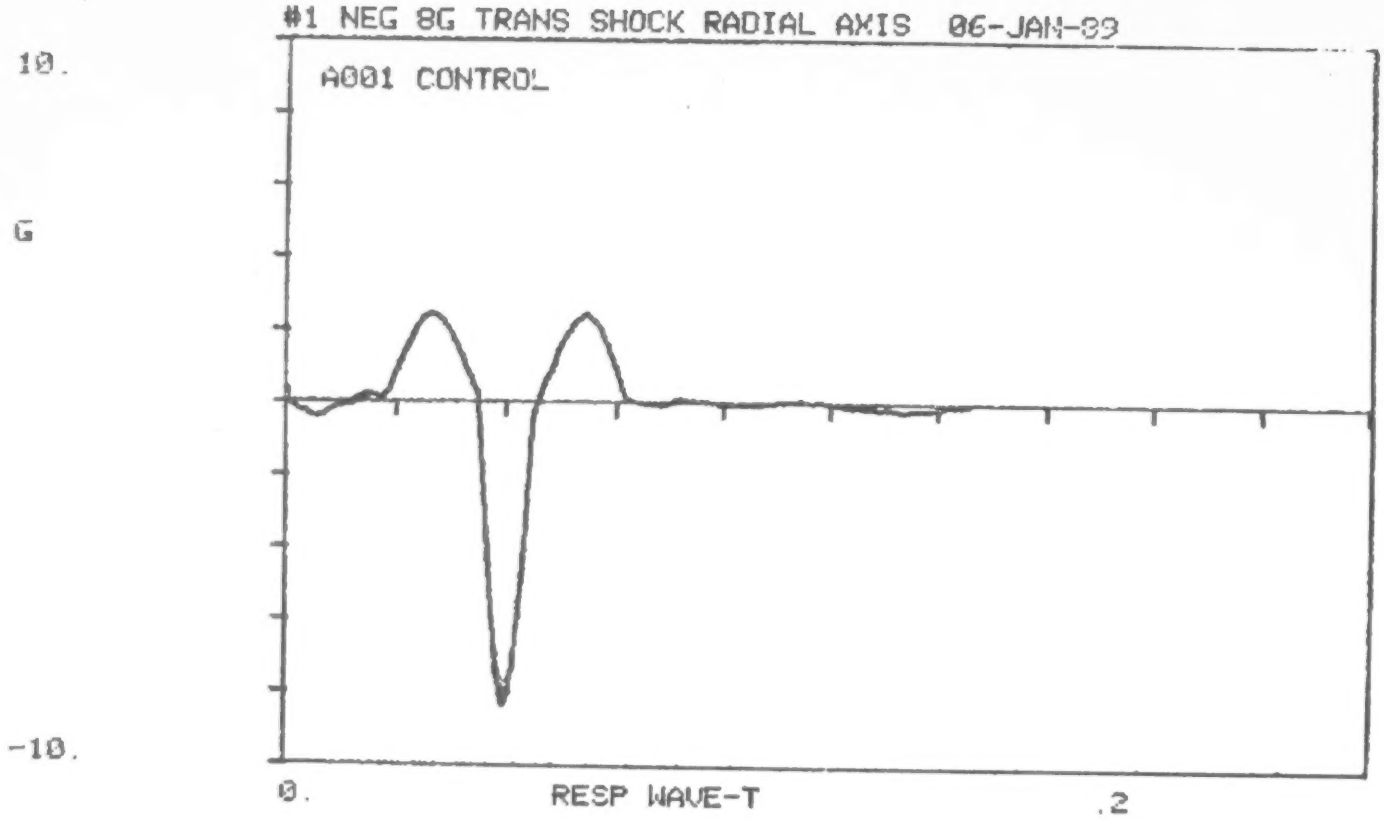
#1 NEG 8G TRANS SHOCK RADIAL AXIS 06-JAN-89
A001 CONTROL
10.
G
-10.
0.
RESP WAVE-T
.2

SHOCK SPECTRUM VALUES: FJEPS 8G TRANS SHOCK 06-JAN-89

FREQ-HZ	MAGN-G
12.58	1.956
14.12	2.66
15.84	3.57
17.78	4.687
19.95	6.022
22.38	7.644
25.11	9.639
28.17	11.71
31.62	13.61
35.48	14.91
39.81	15.34
44.65	15.23
50.1	14.72
56.22	13.84
63.08	13.11
70.8	11.68
79.42	12.48
89.11	13.17
→ 100.	12.96
112.1	12.23
125.8	11.57
141.2	11.45
158.4	10.77
177.8	10.
199.5	9.476
223.9	8.588
251.1	8.205
281.8	8.776
316.3	8.805
354.7	8.713
398.1	8.449
446.7	8.247
501.2	8.467
562.5	8.377
630.9	8.159
708.1	8.315
794.1	8.2
891.3	8.258
1000.	8.164
1122.	8.223
1259.	8.151
1412.	8.11
1584.	8.09
1778.	8.089
1994.	8.059
2238.	8.008
2511.	7.874

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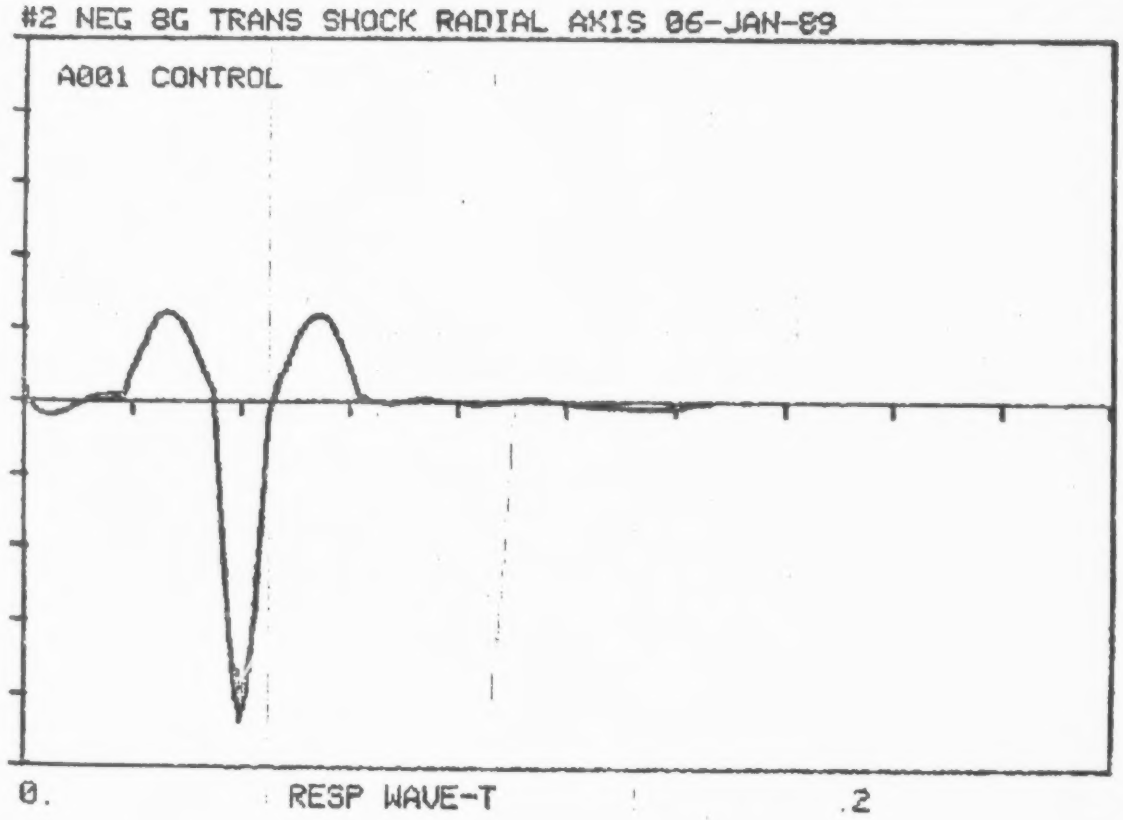
#2 NEG 8G TRANS SHOCK RADIAL AXIS 06-JAN-89
A001 CONTROL
10.
G
-10.
0.
RESP WAVE-T
.2

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SHOCK SPECTRUM VALUES: FJEPS 8G TRANS SHOCK 06-JAN-89

FREQ-HZ	MAGN-G		
12.58	1.954	501.2	0.433
14.12	2.659	562.5	0.342
15.84	3.576	630.9	0.26
17.78	4.696	708.1	0.285
19.95	6.031	794.1	0.184
22.38	7.655	891.3	0.344
25.11	9.653	1000.	0.317
28.17	11.73	1122.	0.368
31.62	13.6	1259.	0.335
35.48	14.9	1412.	0.26
39.81	15.33	1584.	0.212
44.65	15.26	1778.	0.17
50.1	14.79	1994.	0.07
56.22	13.93	2238.	0.069
63.08	13.13	2511.	0.043
70.8	11.62		
79.42	12.32		
89.11	13.11		
100.	12.98		
112.1	12.25		
125.8	11.7		
141.2	11.51		
158.4	10.85		
177.8	10.12		
199.5	9.543		
223.9	8.633		
251.1	8.214		
281.8	8.844		
316.2	8.796		
354.7	8.723		
398.1	8.519		
446.7	8.283		

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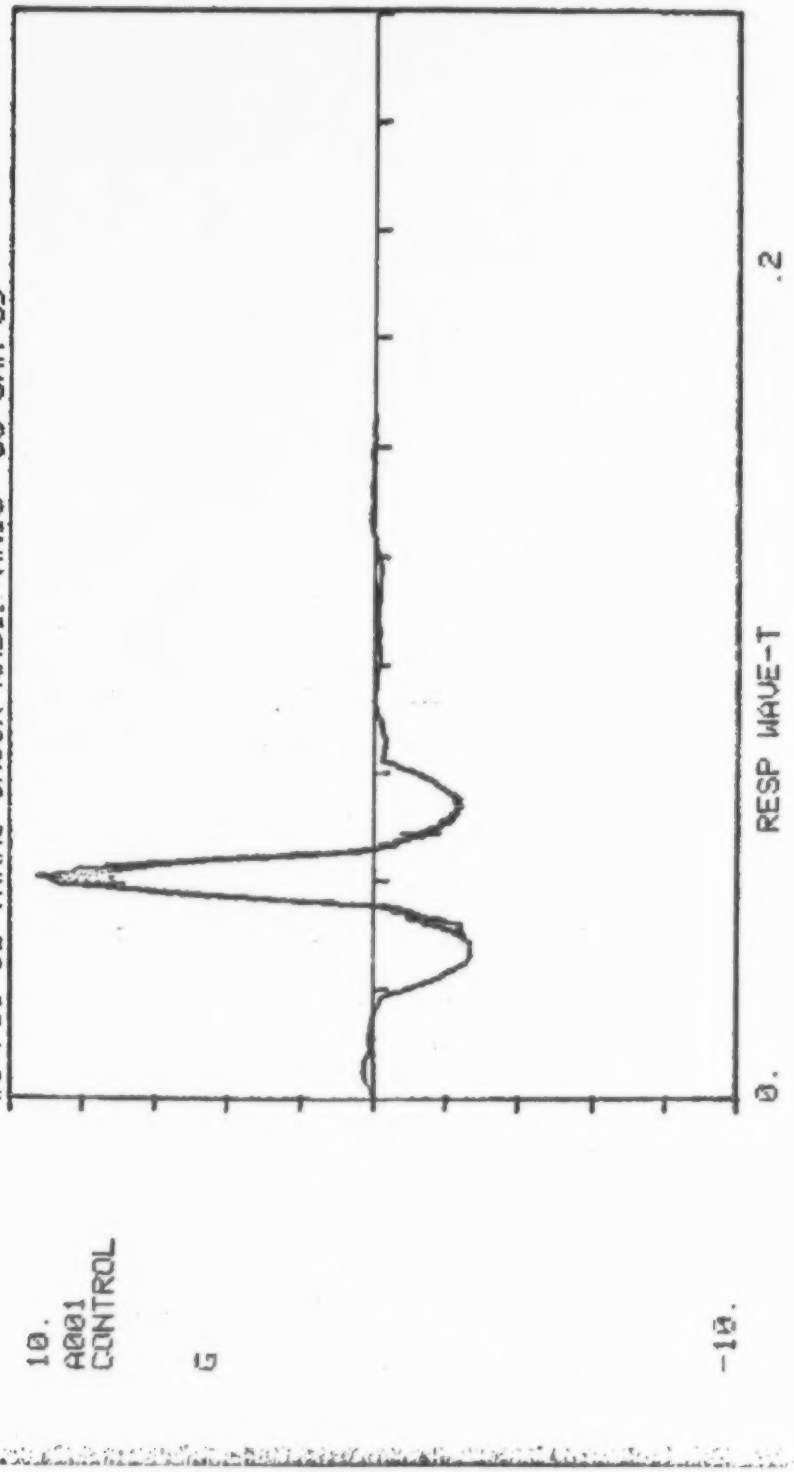

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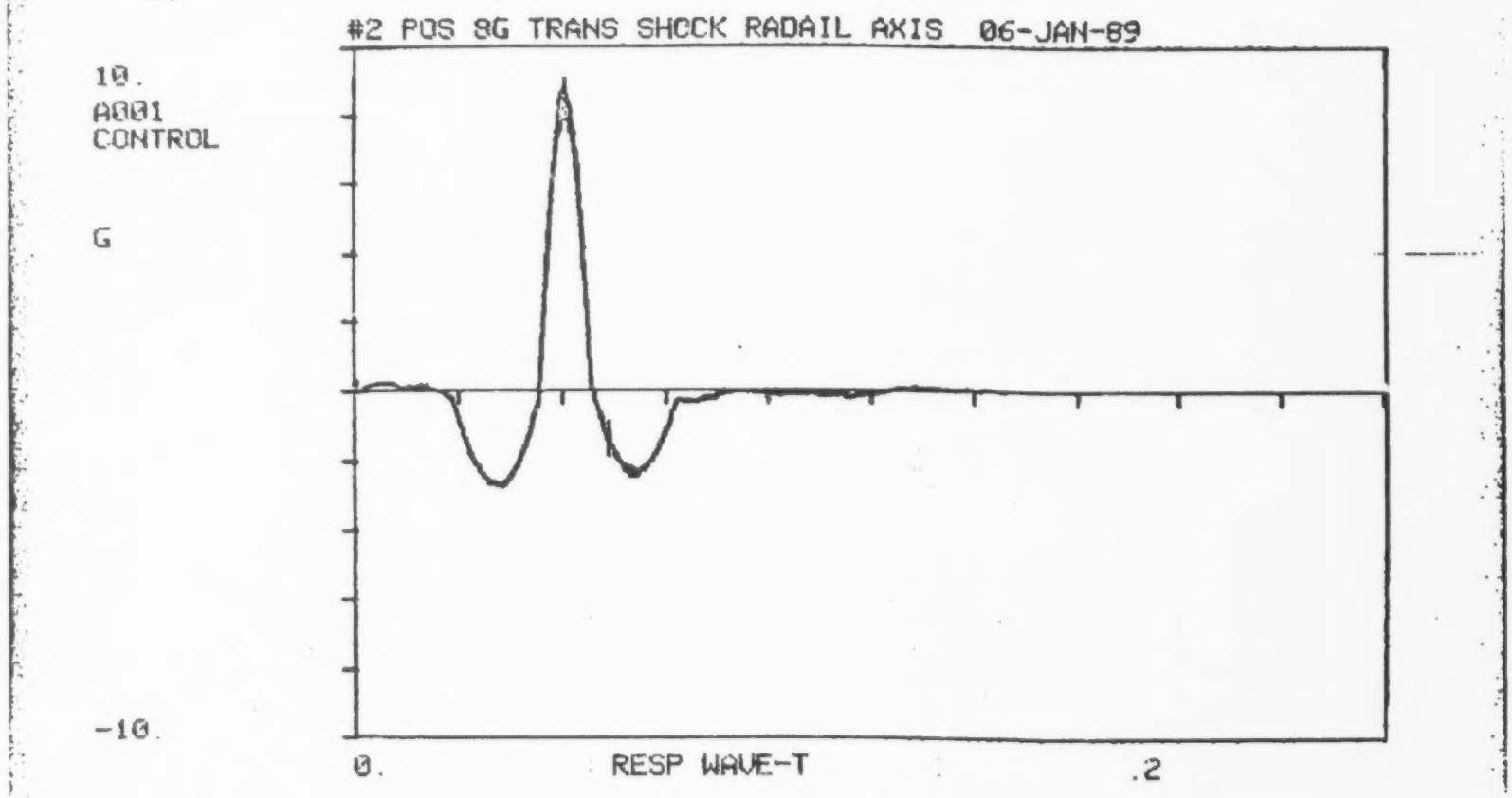
SHOCK SPECTRUM VALUES: FJEPS 8G TRANS SHOCK 06-JAN-89

FREQ-HZ	MAGN-G		
12.58	1.915	501.2	8.737
14.12	2.625	562.5	8.839
15.84	3.555	630.9	8.719
17.78	4.714	708.1	8.514
19.95	6.11	794.1	8.721
22.39	7.752	891.3	8.639
25.11	9.825	1000.	8.572
28.17	11.97	1122.	8.58
31.62	14.03	1259.	8.576
35.48	15.58	1412.	8.688
39.81	16.31	1584.	8.788
44.65	16.35	1778.	8.993
50.12	15.8	1994.	9.101
56.22	14.68	2238.	9.31
63.08	13.65	2511.	9.228
70.9	12.58		
79.42	13.39		
89.11	13.86		
100.	13.44		
112.1	12.54		
125.8	12.		
141.2	11.95		
158.4	11.33		
177.8	10.51		
199.5	9.958		
223.9	9.142		
251.1	8.56		
281.8	8.212		
316.3	8.225		
354.7	8.265		
398.1	8.829		


#2 POS SG TRANS SHOCK RADAIL AXIS 06-JAN-89
10.
A001
CONTROL
G
-10.
0.
RESP WAVE-T
.2

SHOCK SPECTRUM VALUES: FJEPS 8G TRANS SHOCK 06-JAN-89

FREQ-HZ	MAGN-G
12.58	1.925
14.12	2.625
15.84	3.562
17.78	4.728
19.95	6.123
22.38	7.792
25.11	9.868
28.17	11.99
31.62	14.07
35.48	15.63
39.81	16.35
44.65	16.42
50.1	15.85
56.22	14.71
63.08	13.65
70.8	12.55
79.42	13.32
89.11	13.85
100.	13.44
112.1	12.52
125.8	12.02
141.2	11.97
158.4	11.34
177.8	10.54
199.5	9.941
223.9	9.091
251.1	8.502
281.8	9.174
316.3	9.251
354.7	9.106
398.1	8.84
446.7	8.578
501.2	8.855
562.5	8.774
630.9	8.534
708.1	8.705
794.1	8.598
891.3	8.634
1000.	8.554
1122.	8.737
1259.	8.582
1412.	8.569
1584.	8.59
1778.	8.488
1994.	8.59
2238.	8.593
2511.	8.618

Appendix B

MEMO A400-FY89-139, "REDLINE TO CTP-0054, REV. C, 'QUALIFICATION TEST PLAN FOR FIELD JOINT ENVIRONMENTAL PROTECTION SYSTEM VIBRATION/PRESSURIZATION TEST'"

Note: The redline changes specified in this memo have been incorporated into CTP-0054, Rev. C. Revision C was accepted by NASA on 16 Feb 1989.

MORTON THIOKOL, INC.

Aerospace Group

Space Operations

4 January 1989
A400-FY89-139

TO: Distribution

FROM: J. D. Thirkill

SUBJECT: Redline to CTP-0054, Rev. C, "Qualification Test Plan for Field Joint Environmental Protection System Vibration/Pressurization Test"

NASA has already approved the redline change. However, there is one area that was not marked up. Sheets 15 and 16 that are in question are attached.

These changes are required to finish the vibration test on the joint protection system hardware at T-57.

The Test Plan will be rerouted for engineering traceability.

J. D. Thirkill

Attachments: As stated

TABLE II

FJEPS TEST CRITERIA

TEST	SPECTRUM & TOLERANCES	NOTES
FLIGHT RANDOM VIBRATION	20 - 50 Hz @ 0.020 g^2/Hz 50 - 150 Hz @ +3 dB/oct. 150 - 500 Hz @ 0.060 g^2/Hz 500 - 2000 Hz @ -6 dB/oct. 2000 Hz @ 0.0038 g^2/Hz Composite = 6.9 g_{rms} Duration = 360 seconds/axis Tolerances Composite Amplitude ± 10% PSD Amplitude +100%, -30% Frequency ± 5% Duration ± 10%, - 0%	For the initial 160 seconds of the vibration test, pressurize the test article as noted in the internal pressurization test (section 8.1.2 A-E).
REENTRY RANDOM VIBRATION (Radial Axis)	20 Hz @ 0.036 g^2/hz 20 - 180 Hz @ +6 dB/oct 180 - 280 Hz @ 3.13 g^2/hz 280 - 2000 Hz @ -6 dB/oct 2000 Hz @ 0.059 g^2/hz Composite = 35.2 g_{rms} Duration = 90 seconds/axis For test tolerances, see Flight Random Vibration (above).	None. 1000-2000 HZ SYSTEM RESONANCES IN THIS RANGE EXCEEDS PSD AMPLITUDE TOLERANCE.
(Tangential & Longitudinal Axis)	20 Hz @ 0.0039 g^2/hz 20 - 80 Hz @ +6 dB/oct 80 - 275 Hz @ 0.063 g^2/hz 275 - 560 Hz @ -9 dB/oct 560 - 2000 Hz @ 0.0075 g^2/hz Composite = 5.6 g_{rms} Duration = 90 seconds/axis For test tolerances, see Flight Random Vibration (above).	None.

TABLE II

FJEPS TEST CRITERIA (cont.)

TEST	SPECTRUM & TOLERANCES	NOTES
VEHICLE DYNAMICS CRITERIA (Longitudinal Axis) (Lateral Axis)	3.5 - 5 Hz @ 1.0 G's peak * 5 - 40 Hz @ 1.0 G's peak 2 - 5 Hz @ 1.7 G's peak * 5 - 10 Hz @ 0.6 G's peak 10 - 40 Hz @ 1.7 G's peak Sweep Rate = 3 Oct./Min. (1 Sweep from low to high frequency). Tolerances Peak Amplitude +20%, -10% Frequency ± 5% Duration +10%, -0%	For the initial 160 seconds of the vibration testing, pressurize the test article(s) as noted in the internal pressurization test (section 8.1.2 A-E). * Design Criteria Only.
SRB WATER IMPACT SHOCK CRITERIA (Longitudinal Axis) (Radial and Tangential Axis)	20 G's peak, 0.050 second, ½ - sine pulse. 2 shocks in flight direction. 8 G peak, 0.050 second, ½ - sine pulse. 2 shocks in each direction. Tolerances (for both) Amplitude: +40%, -20% Pulse Overshoot: +20% Duration: ± 10%	Long duration (0.1 - 0.15 sec) pulses are impossible to achieve on most electrodynamic shakers (0.070 - 0.080 sec. being about the limit). Since the majority of the test article response lies in the higher frequency range (compared to these lower frequency pulses) the pulse duration can be decreased to 0.050 sec. with negligible effect.

Appendix C

DISCREPANCY REPORTS NO. 168169 AND NO. 168188

MORTON THIOKOL, INC.
Wasatch Operation

DISCREPANCY REPORT

TOTAL SHEETS: X

| | | |

MORTON THIOKOL INC.
Wasatch Operations

DISCREPANCY REPORT

TOTAL SHEETS: X

1 PROGRAM: SPACE SHUTTLE	2 PROGRAM CODE: FE	☐ TC NON CON MATL CUST GOVT FURN ITEM ☒ VENDOR NON CON MATL PROCESS DEPARTURE	№ 168188	4 PROJECT NO: HQ302	5 PASS ORDER NO: 7A053000001	6 CONTRACT CODE: CMJ
7 ASSEMBLY PART NO: 7U76358-01	DASH: N/C	8 ASSEMBLY SERIAL NO: 0000001	9 NAME OF ASSEMBLY: F JEPS VIB / PRESS	10 VENDOR NAME: N/A		11 VENDOR CODE: N/A
12 DISCREPANT PART NO: 7U76358-01	REV: N/C	13 DISCREPANT SERIAL NO: 0000001	14 NAME OF DISCREPANT PART: F JEPS VIB / PRESS	15 RECEIVING REPORT NO: N/A	16 PURCHASE ORDER CONTRACT NO: N/A	

17 TOTAL QTY INSPD	18 TOTAL QTY REJ	19 UM	20 TOTAL QTY DISCREPANT	21 DISC NO	22 MFG HOLD AREA	22A OCO NO	22B ITEM NO	22C MFGR	22D MFGR TYPE	22E REV	22F CAGE	22G PART NO	22H REV	22I OP NO	22J STEP NO	22K RELSE	22L RELSD	22M DATE RD
27	ONE	EA	ONE	T-53	T-33-T	N/A	1-17	AA	P	N/A	N/A	N/A	7A053	00	150	130	N/A	N/A	NA

23 ITEM NO	24 QUANTITY	25 PRED	26 ACCEPTED UNDER	27 REFERENCE DOCUMENT	27A UM
01	ONE	NA	N/A	CTP-0054 REV "B" PAGE 16 TABLE TWO	EA

DESCRIPTION

28 SHOULD BE: IMPACT SHOCK CRITERIA, TANGENTIAL AXIS 8 G'S PEAK

CONDITION IS: OVER SHOCKED PART TO 19.77 G'S TOTAL.

NOTE: CAUSE UNKNOWN

29 INITIATOR	CODE	TIME	DATE	30 SUPERVISOR APPROVAL	TIME	DATE	31 CUSTOMER ACKNOWLEDGEMENT	TIME	DATE
SCOTT WILSON	B224	1500	01/04/89	[signature]	1509	01/04/89	N/A		

CAUSE

32 CAR TO TEST ENGINEERING (Robert Nielsen)

Preliminary Cause Code 04
Preliminary Cost Center 5632

33 CAUSE CODE: N/A
34 RESP C/C: N/A

CORRECTIVE ACTION

35 CAR

SDEDB DEF PARA ____ HC ____ DC ____
DR ____ PCI ____ MB ____
MOTOR NO. ____ RETEST ____
CRITERIA ____

NOTE: REF N.D.-168169

36 CA DETERMINED BY	COST CENTER	DATE	37 EFFECTIVITY SERIAL NO	38 EFFECTIVITY DATE	39 CAR NO
MARK SWABSKY	8830	01/04/89	NA	NA	21465

DISPOSITION

40 ITEM NO	41 QUANTITY	42 DISP CODE
01	1	2A

43 FINAL MOST SEVERE DISPOSITION: Acceptable Departure

44 ACCEPTABLE DEFECTIVES. NO VISUAL DAMAGE TO TEST ARTICLE. OVERTEST MET AND EXCEEDED TEST REQUIREMENTS. DATA FROM THIS TEST WILL BE ACCEPTABLE. FACILITY CHECKOUT WILL BE RELEASED TO VERIFY THE INTEGRITY OF THE SHOCK SYSTEM BEFORE TESTING IS CONTINUED.

CM Rel 1-5-89 Robert Nielsen 1/5/89 RLE 1/5/89

45 CUST GOVT WAIVER	46 CI'S AFFECTED	47 END CATEGORY	48	49 TC ENGR APPROVAL / DATE	51 CUSTOMER APPROVAL / DATE	52 GOVT APPROVAL / DATE	53 DR RELEASED BY	54 DISPOSITION
☐ YES ☒ NO	☒ YES ☐ NO	N/A	☒ PD ☐ PMR ☐ MRB	[signature] 1-5-89	N/A	N/A	31681 P M R W	31725 W
				50 TC QA APPROVAL / DATE: [signature] 1/5/89			01/05/89	01/06/89

THIS APPROVAL DOES NOT CONSTITUTE A WAIVER BY THE GOVERNMENT OF ANY CLAIM FOR EQUITABLE PRICE ADJUSTMENT AS THE CONTRACTING OFFICER MAY DEEM APPROPRIATE BECAUSE OF SUCH WAIVER. THIS DISPOSITION DOES NOT ESTABLISH PRECEDENT FOR FUTURE DISPOSITIONS

№ 168188

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